British Society for the Study of Orthodontics.

1934.

TRANSACTIONS
OF THE
BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS
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London :
PUBLISHED FOR THE SOCIETY BY
THE DENTAL MANUFACTURING COMPANY LTD.
BROCK HOUSE, 97, GREAT PORTLAND STREET, W.1

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ANNUAL GENERAL MEETING:
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ORTHODONTIC TREATMENT FOR THE ELEMENTARY SCHOOL CHILD.

Presidential Address by BERTRAM SAMUEL, L.D.S.Eng.

OF the many communications that have been out before this Society in the past, I must own always to have been more particularly interested in the views presented on two subjects, both of which recur constantly in our *Transactions*. One is " Postgraduate Education in Orthodontics," and the other " The Orthodontic Treatment of the Mass of the People in this Country." And it is on various aspects of this latter that I desire to dwell now.

The elementary school population of England and Wales is approximately 5½ millions, and, as you are aware, medical and dental inspection with, subsequently, facilities for treatment, was introduced in 1907; both have made yearly advancement in scope and utility ever since. Some of us are of opinion that the dental arrangements have lagged a great deal behind the admirable medical organisation. But before being too critical I think we should be a little sympathetic towards the difficulties of the authorities, for the need of dental treatment being widespread, and the onslaught of dental caries being recurrent, make it appear that the dental service is a very expensive one; as, for instance, a child who is medically examined but three or four times in its school career of nine years will need a dental inspection at least once a year.

It may not be generally appreciated that what are known as routine medical inspections are held on the child's first admission to school, and at the ages of 7 and 11 years (though some authorities do this at 8 and 12). In London the child is examined also in the term previous to its leaving school, though this is not a statutory obligation. In addition to the children of these groups, the school doctor sees only such as are put before him for special reasons. The examination is a very thorough one; about twenty are seen in a morning or afternoon session, and the parents are invited and expected to be present.

The dentist's annual inspection is quite different to this, since it does not take more than a fraction of a minute to decide whether or no a child requires dental treatment. Usually the children file before the dentist in turn, and in this manner some 100 to 120 can be inspected at the school in a morning or afternoon session.

During the year 1932 about 70 per cent. of those inspected by the dentist required treatment. On the other hand, the routine medical inspections that were held during the same period show that less than 19 per cent. required medical attention (this figure excludes dental disease and uncleanliness).

It is almost a truism that a more extensive school dental scheme

would be of considerable benefit to the nation, and a wise economy in the long run, since it is obvious that where dental treatment facilities are poor, saveable teeth will become unsaveable, and the dentist will have to spend his time in extracting the remains of permanent teeth which should have earlier been made good for the patient's lifetime. I cannot do better here than quote Sir George Newman, the Chief Medical Officer of the Board of Education, who in his Report for the year 1932 says : " There can be no doubt that a substantial increase in expenditure (on the dental service) would not only result in sorely needed extension of that service, at present little more than initiated in most educational areas, but it would be definitely economical in the sense of insuring the ultimate value of the preliminary inspection and treatment of the teeth. To make a child's teeth sound at 8 years of age and neglect them thereafter is not, in the long run, economical but rather extravagant ; to provide dental treatment effectually in area A and neglect to do so in area B is partial, inequitable and nationally ineffective ; to fail to follow up the business in later school life or in adolescence is short-sighted."

I hope it will be considered the duty of the dental profession to continue to keep these matters to the fore, to the end that public opinion may be educated and a well-organised and complete dental service for juveniles be accepted as an early charge on the health service of the community.

We must, however, be thankful for the fact that of the 316 authorities who come under the Board of Education, all but two make some provision for the dental treatment of the children under their care, though in most cases the provision is admittedly inadequate and in many extremely sketchy.

Some years ago we in this Society had an interesting paper read by Mr. Frank Steadman in which he reminded us that those who were economically in a position to receive elaborate orthodontic treatment were but a small fraction of the total child population. I was convinced then, as now, of the soundness of this view, for leaving out of account any question of direct payment to the dental practitioner, the expense of frequent journeys and the loss of time must remain very real deterrents to any parent, more especially to those who are wage-earners.

In the discussion on this paper, the view was expressed by Mr. Harold Chapman and others that orthodontics for the masses must be considered as secondary to the adequate treatment of dental disease, from which we must infer that a public dental officer is only entitled to give time to orthodontic treatment if he is able satisfactorily to treat dental decay and oral sepsis in the children allotted to him. Of course, his ability to do this would depend on the number of children so allotted. If we take the ratio of school children to dental officer, we find that the number for England and Wales is 9,000 per dental officer, but that in some areas the school population is as many as 20,000 per official dentist. Essayists and speakers before this Society and elsewhere have given figures varying from 2 to 50 as the percentage of orthodontic defects. This divergence of views draws attention to the need for a standardised investigation of this question by our profession.

I am taking this opportunity to recant views which I gave to this Society nearly fifteen years ago. In a paper read in 1919 I made a plea for the establishment of an orthodontic centre in Central London, where all school children who required treatment could be referred, and where, in addition, orthodontic instruction could be given to dental surgeons. For the past two years I have acted as Dental Adviser to the London County Council and have been enabled to look more closely into matters which then I only gazed at from outside. While possibly in other areas it may be feasible to centralise dental or orthodontic work, I am convinced now that in a district the size of London, the ideal is for any orthodontic treatment to be done through the co-operation of the dentist working at the local treatment centre.

May I briefly here tell you of the dental arrangements made in the metropolis? It may be of some interest, for, indeed, I find that most of my London confrères are unaware of the magnitude of the dental commitments of the London County Council, which are by no means limited to children.

There are about seventy centres where dental treatment is carried out for school children, the work being done by ninety-seven part-time dentists, of whom sixty-seven act as inspecting dentists in the schools. During 1932 2,462 inspecting sessions were held. These ninety-seven part-time dentists are equivalent in the number of sessions they give to the work to forty-three full-time officers. There are in addition to the day scholars 9,000 children in boarding schools, known officially as residential schools or children's homes. All of these are inspected by a dentist twice a year and the necessary treatment is carried out for them subsequently.

The Council also controls general and special hospitals having a total of approximately 40,000 beds, and the mental hospitals in addition. With the exception of the fever hospitals, where the patients' stay is usually short, arrangements have been made for a dentist to visit—usually weekly or twice weekly—all of these institutions.

In addition to routine treatment, dentures are supplied at public expense for those cases where the medical superintendent of the hospital considers that such provision is a necessary ancillary to the medical or surgical treatment of the patient. The dentures are either supplied by the visiting dental surgeon or constructed under his direction in the Council's dental laboratory.

I must also mention the Plastic Surgery Unit directed by Sir Harold Gillies, which does such beneficent and beautiful work with the co-operation of our members—Mr. A. E. Hardy and Mr. A. L. Fraser.

This is all on the public health side, but dentistry also figures in the programme of the Public Assistance Committees and under the Education Officer classes are held for the training of dental mechanics in various Evening Institutes.

Limiting ourselves to the children, it will be noted that the seventy treatment centres, where dentistry is practised, are dotted all over the county. The aim is to have each one geographically convenient to a group of schools, for it is only by arranging for treatment to be easily accessible for the child and its parents that we are able to get a good proportion of the work done. The

Council's policy is to make use of existing institutions where possible, and many of the treatment centres are domiciled in dispensaries and in well known hospitals. Others are established in small suburban houses, only distinguishable from their neighbours by a name board and the ever-open door.

At present no mechanical orthodontic treatment is carried out at any of these treatment centres. Such cases as the dentist feels he is unable to undertake without some form of appliance are recommended to go to one of the five London dental schools or to the Eastman Clinic. Before criticising this routine, we must remember that if the Council were able and willing to treat all its own orthodontic cases, the dental schools would be hard put to it to find material for the instruction of their students in this subject.

However, I am hopeful that in the near future specially selected orthodontic cases may be treated at the dental centres with appliances made at the Council's dental laboratory. Such an arrangement should prove of great benefit to those parents for whom the expense of long and frequent journeys across London is a great consideration, and should make an interesting variation from routine for the dental officer.

It is difficult to restrain one's enthusiasm in speaking of the general conditions under which the children live in the twenty odd residential schools to which I have already referred. These beautiful estates situated for the most part in the Home Counties outside the County of London proper are filled mostly with happy and healthy youngsters, and it is here that the dental surgeon has his greatest opportunity. For, given the combination of a well-balanced dietary, training in oral hygiene, discipline and regular professional attention, it is possible to send these youngsters out into the world with a proper dental equipment. It is not inappropriate to quote here from the presidential address delivered in 1910 by Dr. Sim Wallace—he then said: "I dream of the day when children may be permitted to live under environmental conditions which will not only prevent the irregularities of the teeth, but will also prevent the ill-health and its results which are so painfully depicted on the faces of four-fifths of the children of the present day."

Perhaps Dr. Sim Wallace might consider that we in London are on the road towards his Utopia.

Mr. Badcock, in proposing a vote of thanks to the President for his address, assured him that in all the previous presidential addresses through which he had looked, he had not found one more valuable, interesting and instructive. Coming as it did with the President's authority as Adviser to the London County Council and as President of this Society, it should carry weight in quarters where propaganda was needed. It covered a wide field and was not a paper for discussion, but members had learned much from it, and few of them had known that the Council was nearly as active in treating the teeth of children. He was sorry that a much larger attendance had not been present to hear the address.

Mr. Northcroft, in seconding the vote of thanks, said that he looked forward to seeing the address in print. It would have done the whole Society much good to hear.

The vote of thanks was carried with acclamation.

VALEDICTORY ADDRESS

By H. G. Watkin, L.D.S.

Looking back over the past year, the thing which strikes me most is the progress which has been made with the use of stainless steel for orthodontic purposes. Dr. Friel's paper, published in the July issue of the Dental Record, is excellent and comprehensive. He told us about a year ago that he had used stainless steel exclusively in his practice for twelve months. Quite a number of our members are using or experimenting with stainless steel, and I personally have used no gold for the past eighteen months. I started making joints by binding with tinned copper and soft soldering, then became an advocate of hard silver soldering, and now I have changed over entirely to welding, with great success. With a welding machine in which the current is automatically controlled (that is, the personal element is eliminated) for all the smaller gauges of wire, it is possible to guarantee a perfect weld every time. I should be very interested to know what success members are having who are using a battery as a source of electric supply, a method by which it is most difficult to control the current for the smaller gauges of wire.

In my presidential address I mentioned a case in which an upper central incisor was short and would not respond to orthodontic treatment, and I promised to report later on as to progress or otherwise. I think this is an opportune time to fulfil my promise, and I will put the slides on the screen to refresh your memory.

Slide I shows the original condition : $\underline{1}|$ is short and impacted and $\underline{3}|$ lingual to $\overline{3}|$.

Slide II shows that after some time $\underline{1}|$ had not moved but all the anchor teeth had moved. This made me try to find another cause and I thought I had discovered it when I ascertained that the patient was in the habit of biting a pencil. However, the removal of the apparent cause had no happy effect. Next I blamed the tongue, which when at rest protruded underneath the incisal edge of the central. A plate with a flange which held the tongue clear was also a failure, so in desperation I produced what I call a commercial result shown in—

Slide III. Under an infra-orbital regional injection I drilled two small holes lingually, one on each side of the pulp, and using these as anchorage, I built up a tip with Kerr's inlay wax, cut the front away and faced it with carefully matched synthetic cement. Fortunately the upper lip is long, and even when laughing does not reach the joint. The front was shaped by means of a celluloid tooth form to match the other central. The parents and the patient are quite pleased, but I am not satisfied, because from an orthodontic point of view it is a failure. I should be very glad to know if any member present has had a similar experience and been unable to move a tooth.

On behalf of the Society I wish to thank all members who have contributed to the success of the session over which I have presided, and especially to thank the officers and committee, one and all, who have so efficiently served us.

It is now my duty and privilege to invest our new President,

Mr. Bertram Samuel, with this badge of office, and n doing so I wish him every success and know that he will have the same support that I have enjoyed from all of you.

DISCUSSION.

Mr. NORTHCROFT asked if the President had used X-rays.

The PRESIDENT replied in the affirmative, and said the tooth was shown to be quite straight. Fortunately the teeth were still vital and did the patient good service. The tooth was certainly not a long one; it was short, and that was why he was so careful not to exert sufficient force to extract it.

Miss SMYTH said she had a case of an immovable central. She worked on it for months, and she thought she moved it possibly 1 mm. or 1½ mm. during that time. At last she felt bound to give the case up as hopeless; but just at that time the patient, a boy, decided to go on the films. He was there still, and did not need any more assistance from her.

The PRESIDENT said he was glad to know there were some other cases.

UNILATERAL POSTERIOR OCCLUSION CASES, AND TREATMENT OF SAME.*

By DR. O. HENRY.

CASES were shown where the occlusion is normal on one side, and the lower arch is in posterior relation to the upper arch on the other side, the distance of one tooth.

In such cases the median line of the lower arch is invariably in distal relation to the median line on the upper arch on the post-normal side; further, if a ruler is placed along the median line of the face, it will be seen that the chin also is distal to the median line of the face on the post-normal side.

Treatment consisted in correcting the irregularity in the arch form, both in the upper and lower arches first, that is removing the mechanical interference which prevents the lower arch from occupying its normal position, then adjusting a bite plane, so that the patient can bite only in the normal position, and using intermaxillary elastics on the post-normal side.

A USEFUL APPARATUS FOR MAKING SYMMETRICAL PLASTER MODELS.*

MRS. POSSENER MICHAELIS.

THE apparatus consists of a bakelite stand, a glass slab and four stainless steel frames of different sizes.

Plaster is poured into the impressions to cast the tooth portions only first, a steel frame of suitable size is then chosen and the upper model made, using the markings on the back wall of the bakelite stand as a guide to the height.

The tooth portion of the lower impression is then attached to the finished upper model with an elastic band, and the lower model completed.

It is important to make the bases of the two models parallel, and to use a little sticky wax to prevent the steel frames from moving during the casting. After a little practice the apparatus will be found to save much time and to make accurate symmetrical models of a very pleasing appearance. It is called the Gorder model former.

* Demonstration meeting, May 7th, 1934.

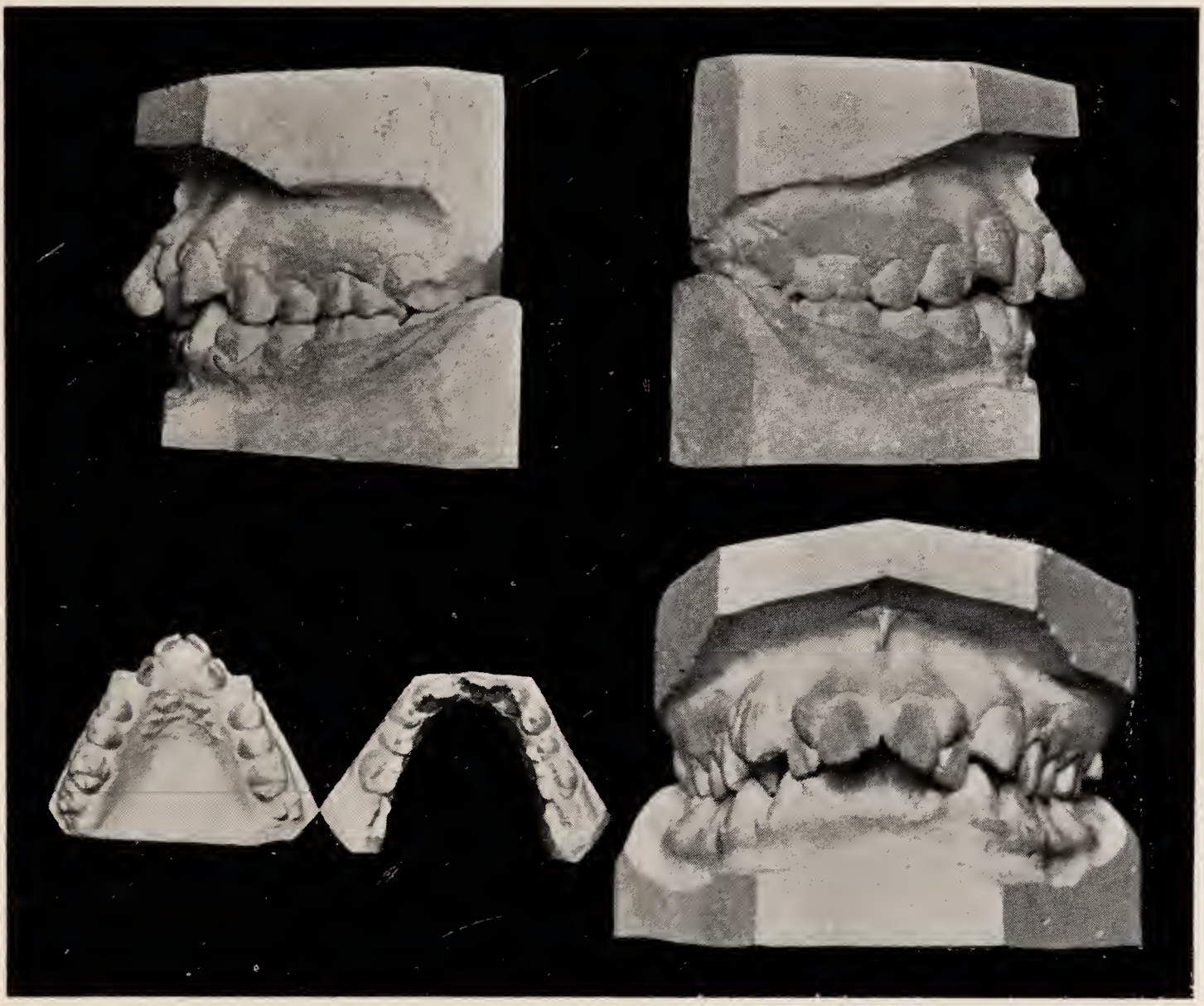
CASES IN PRACTICE.*

By H. E. Marsh, M.C., L.D.S.

Case I.—Angle's Class I.

Underdevelopment at apical base area of premaxillæ. Crowding of incisors in both jaws, with proclination of upper centrals.

The before-treatment models were taken at age 15.2. The patient is a well-developed girl; the face is well proportioned, except in the front of the mouth The teeth show a great deal. The upper lip is short. There is a flatness about and beneath the nasal alæ, but the balance between the middle and lower thirds of the face, externally, is good.



Before Treatment.

She had been under treatment by means of removable plates for four years, when the first models shown were taken.

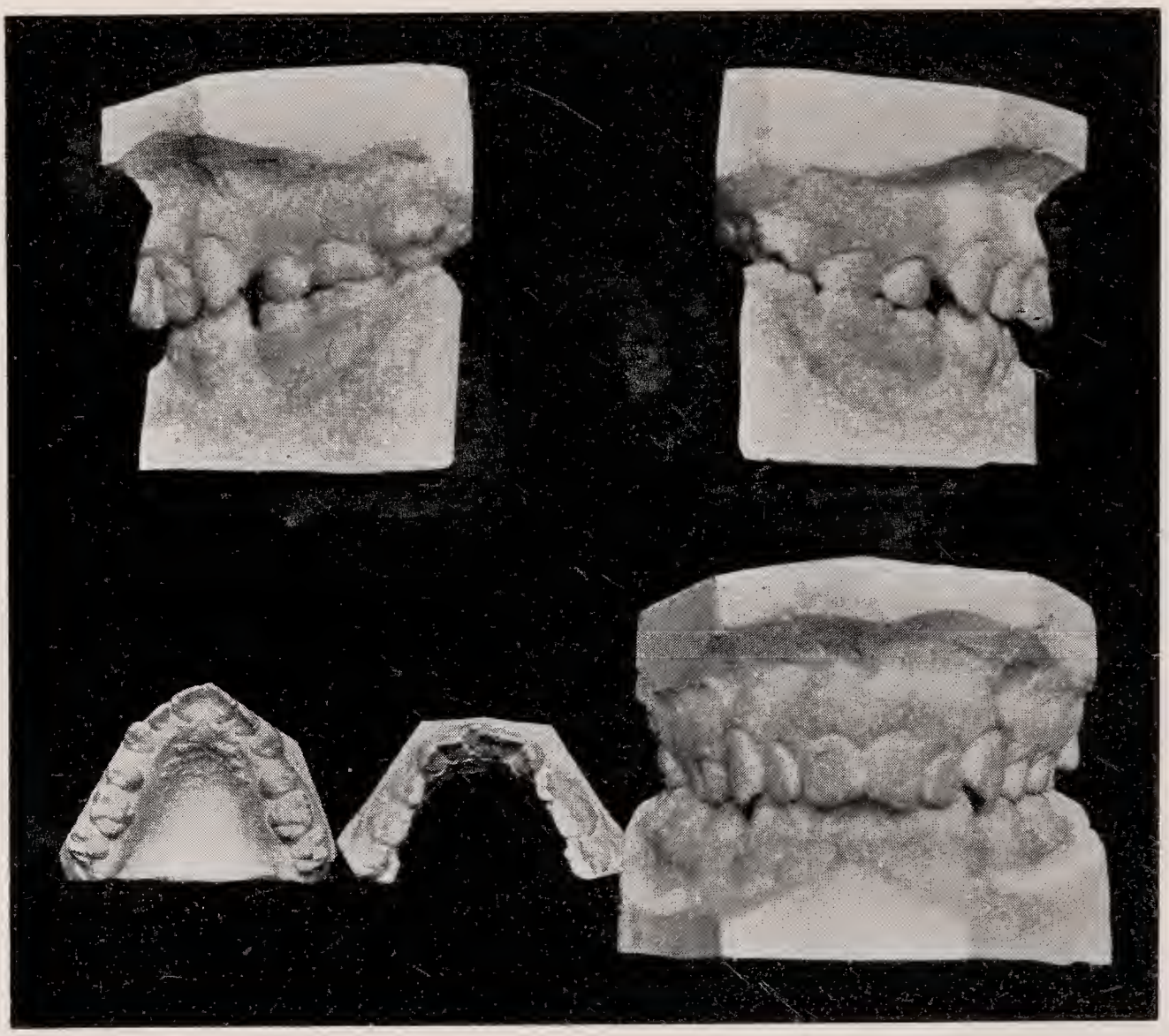
The patient is of a temperament unsuitable for removable plates.

* *Transactions* of British Society for the Study of Orthodontics, 1934.

Case 1.

At age 15, her parents were in despair about her disfigurement. It was decided that the four first premolars must be extracted, and this was done at age 15.4.

At age 15.5, fixed appliances were instituted and the patient was able to tolerate them. Treatment was directed to the rotation and retraction of the upper incisors and the backward movement of the canines, by means of a labial arch, Jackson's type of springs acting reciprocally between central and central and lateral and lateral, and by means of intermaxillary elastics. In the mandible a lingual arch was used with auxiliary springs for alignment of the left central and lateral incisor and the backward movement of the canines. Prolonged attempts were made to move the left second molars, upper and lower into occlusion, without success.



After Treatment.

First, independently of the appliances anterior to these teeth, an intermaxillary elastic from the buccal of the upper to the lingual of the lower was used—ineffectively.

Later, small springs extending backwards from the upper labial arch to the buccal of the upper molar and from the lower lingual arch to the lingual of the lower molar were used—also ineffectively.

Tooth movement proceeded from age 15.5 to age 16.0, and appliances were allowed to remain passive from age 16.0 to age 16.3.

At that age they were all removed and nothing was worn at all until age 16.9, when, owing to the degree of relapse having become somewhat formidable, the use of a removable night plate was found to be capable of being tolerated, and it is still in use, at age 18, and there has been no further relapse.

The second pair of models was taken at age 16.9, when for six months no appliances had been in use.

Case II.—Angle's Class III.

A case of very marked disparity between the growth of the maxillary bones and that of the mandible.

The patient was first seen at age 11, when the incisor teeth were edge-to-edge in occlusion.

At that age the chin was prominent.

The upper teeth are small and the right lateral incisor was totally absent.

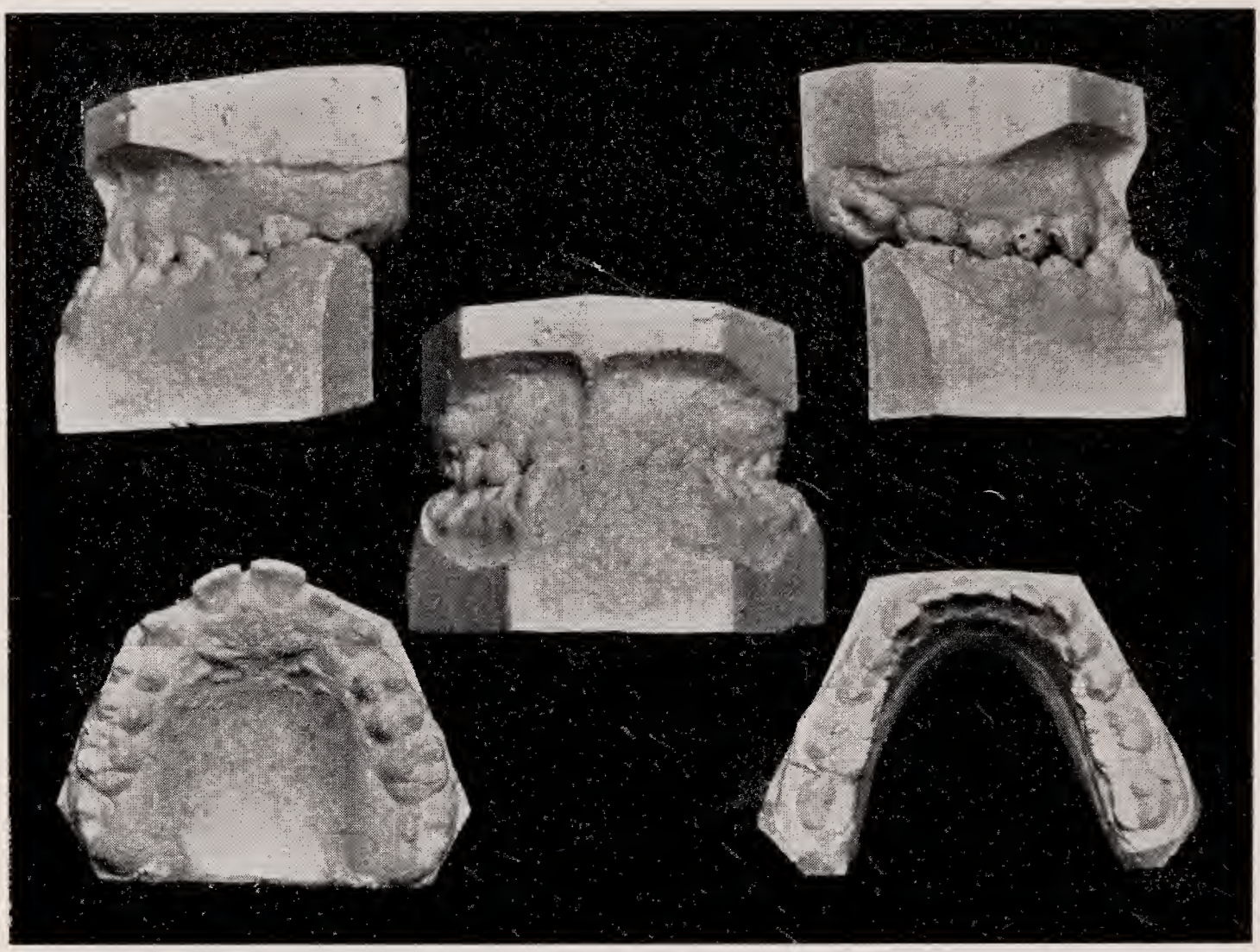
Patient at the Age of 11.

Case 11.

During the six years from age 11 to age 17, efforts to keep the upper and lower arches in some sort of relation to one another have been in progress.

The upper arch has been expanded and, by means of intermaxillary elastics, the upper teeth have been moved forwards and the lower backwards.

Also for two years a head and chin cap with elastics has been worn at night.



Patient at the Age of 17.

In spite of these measures, the mandible has continued to develop in a forward direction and the alveolar process and teeth have advanced to such a degree as the slide shows, where the upper first molars are in occlusion with the lower second molars, and the lower incisors bite in front of the uppers.

The patient is a very slightly built person in all other respects than in that of the mandible, and is very sensitive indeed about the matter, so much so that I was unable to obtain a photograph of her profile to show the meeting. I can obtain from her parents no history of a similar condition in any of her forbears, on either the father's or the mother's side.

Discussion.

Mr. G. Northcroft said that he was surprised that he did not mention, when the case came up for discussion before, the advisability of reducing the number of units in the lower jaw to make the size of the mandible more nearly correspond with the size of the maxillæ, especially as there was a right maxillary lateral missing. The rational treatment would have been to extract some teeth from the mandible, which was obviously too big for the maxillæ, even after the expansion. If the child had been suffering from acromegaly, development could not very well have been arrested, but the rate of progress of the deformity would have been considerably slowed down and the child's appearance probably improved.

Mr. J. H. Badcock said that the Society was much indebted to Mr. Marsh for bringing these cases before it, because they reminded members of their difficulties. It helped orthodontists very much to hear of cases which had not gone particularly well—better, perhaps, than it helped them to hear of perfect results. He asked whether the pain which the first patient had suffered had not possibly been due to the treatment having been carried through somewhat rapidly for the patient's age. Another factor that might have contributed towards pain had been the elastic which had been carried from the upper canine to a lower molar. The canine would have been subjected not to a steady strain but to an intermittent strain which varied every time the patient opened her mouth. This would tend to make the tooth much more tender than would a continuous strain in one direction. He disclaimed any idea of criticising the treatment, saying that he was merely asking for information. The second case, he suggested, might almost seem to be one for surgical intervention. The removal of teeth from the lower jaw was the first measure that occurred to him and might have been successful, but to judge from the photographs the jaw was developed to such an extent that mere removal of teeth would perhaps have allowed those that remained to tilt still further back, so that little advantage would have been gained. The case was almost serious enough for removal of a part of the jaw or for an incision across the base of the ascending ramus on either side and a backward displacement of the jaw.

Mr. W. A. Bulleid, in agreeing with Mr. Badcock's remarks, observed that the basal development was abnormal and that nothing short of surgical intervention could possibly improve the condition. He would have consulted Mr. Percy Cole, who would at once have been able to discuss the possibilities. Further reduction in the size of the alveolus would simply accentuate the extraordinary projection of the mental process and make the patient's appearance worse than it was at present.

Mr. H. Chapman described Mr. Marsh's Communication as a valuable lesson. He was, he said, extremely interested to hear that Mr. Marsh had used the chin cap and head net, although these appliances had unfortunately not been successful. He himself had used them a number of times recently and had been gratified with the results, but his patients had not been so old nor the cases so difficult. He had found the method a useful adjunct during the last few years, though until eight years ago he had never used it.

Mr. H. G. Watkin remarked that Mr. Marsh had mentioned some relapse in the maxilla between the canine and the second premolar. He might have found it of advantage to take the second premolar from the mandible instead of the first. The occlusion would then have been definitely more normal and the gaps might have been less pronounced. He agreed with other speakers that in the second case surgical interference was the only suitable treatment.

Mr. N. J. Ainsworth said that he was not quite clear whether in the slide showing an occlusal view of the first case on completion there had appeared any improvement in the lower jaw as a result of the extraction of the first premolars. He expressed a desire to see the slides before and after treatment consecutively. His impression was that there was little more imbrication in the incisors of the lower jaw before than after the case had been completed; in other words, the lower jaw did not appear to have been improved. He wondered whether it would have been possible to treat the case by the extraction of the upper premolars alone, or whether he had overlooked some point which made the extraction of the lower premolars essential.

The Honorary Secretary suggested that Mr. Marsh shared with another distinguished Sussex practitioner—Mr. H. C. Visick—the peculiarity of extreme modesty. When these gentlemen came to show the Society their valuable cases, they always demonstrated cases which they considered to be failures. Members were perfectly well aware that they had thousands of successes; it was only necessary to to go down to Eastbourne or Bexhill to hear of the good repute of Mr. Marsh and Mr. Visick. He asked whether, when the backward movement of the canine was called for in patients over 14, Mr. Marsh made a great point of immediate backward force on those teeth. He preferred himself to exercise retraction within a week of the extraction of the first premolar, using a moderate degree of traction in a backward direction on the canine; and not to leave this operation for a month and then have to use greater force. The second case offered, he said, an interesting point of differential diagnosis between the two quite distinct groups of cases in which the lower teeth bit outside the upper ones. In Angle Class 3 cases there was overgrowth in the lower jaw, and in another group the lower jaw was virtually normal and the upper, although more or less equal in bulk to the lower, was wrong in shape, being shorter from front to back. At the age of 6 or 7 both classes had the same appearance of the upper front teeth biting inside the lower front teeth, and the question of prognosis—the expectation of treatment—was a very important one. Cases in which the upper jaw tended to be short from front to back, associated with a normal lower jaw, invariably did exceptionally well; they worked like a charm; the condition was absolutely stable and the result was marvellous, and everybody was delighted. Class 3 cases invariably went badly, as Mr. Marsh had shown that evening. There were many points in the differential diagnosis. History was one; the other was the characteristic shape of the lower jaw. In cases where the upper jaw was slightly short from front to back the lower jaw was roughly of the shape illustrated in the first diagram, with a fairly square angle. A Class 3 lower jaw had a very open angle, as shown

in the second diagram, and these cases invariably had a bad prognosis. The Honorary Secretary said that he had treated a case of a child of $2\frac{1}{2}$ years with a chin cap and bandage, and it had done very well, though he did not know how it would go in the future. He believed that in acromegaly the teeth were separated on account of interstitial growth of bone.

Mr. MARSH replied that he had had the advantage of Mr. Chapman's opinion when he had first seen the case, and his colleague had agreed that the extraction of one or both lower first premolars might tend to emphasise the prominence of the chin when the arch closed up. He still believed that it was possible that the extraction of one or more lower teeth would have been better, but they had decided otherwise at the time. In using the word pain he had possibly not chosen a good expression; there had undoubtedly been pain in the rotation of the lateral and central incisors, but not very severe. What he had referred to had been the intense stress upon the patient's nervous system as a whole. He had known nothing about the removable appliances; the child had been brought to him at the age of 15 and he had been told that she had had dozens of plates. Her parents had tried every possible means of getting her to wear them; she was a highly-sensitive only child and badly spoilt, with far more personality than either of her parents, and had been completely in control of the whole family of three. The fitting of the bands had been—he assured the meeting—a kind of "thunder over Mexico." He agreed that surgical interference was the treatment now required for the second case, and said that he had spoken to the parents about it. They lived in Cheshire, so it would not be very far for them to go to see Mr. Watkin, when possibly the Society might hear of another graphic case like the one which their ex-President had done for Mr. Simpson some years before. Mr. Watkin was right, he thought, in suggesting the extraction of the second premolars instead of the first.

Mr. Ainsworth who had suggested that the extraction of the lower premolars was not necessary and that the case might not really be in Class 1 might be correct. Mr. Marsh invited him to inspect the models and to say whether he thought there had been any improvement in the mandible.

He had strong views, he declared, on the subject of starting to move the canines backwards into their sockets within a week of extraction. He had once extracted two lower premolars and started to exert force on the canines about four days after the extractions had been done. The appliances had been fitted and the springs set to work. He had not been using elastics, but finger-springs from a lingual arch. The parents had rung up about nine miles from his residence, and he had had to go out to see the child; she had had a tremendous swelling on the right side of the lower jaw and a temperature of 103°, with tenderness of the lower border of the mandible, and he had not been sure whether she had an acute glandular infection. He had removed the appliance and the next day the temperature had sunk to normal and the swelling had begun to go down, and recovery had been swift. He had always afterwards believed it to be bad to start pulling canines back into sockets which were no more than

wounds. The child had possibly got an infection in the socket and the condition might have had no connection with the pressure, but he had been frightened by the case and had never done the same thing again, but always now waited six weeks.

He promised to bear in mind the Hon. Secretary's (Mr. Cutler) diagnostic point concerning the shape of the mandible and its significance for prognosis.

THE "TIME FACTOR" IN ORTHODONTICS, PARTICULARLY IN REGARD TO EXTRACTION.*

By G. F. Cale-Matthews, L.D.S.

This evening I quite realise that I am touching a side of orthodontic study which is not usually discussed in a scientific society, nevertheless, as a part of practice, what I have to suggest has a very distinct and marked influence on the ultimate result of one's treatment.

Assumptions of treatment calculations in the matter of time rarely if ever work out in a definite or exact manner, and it may be a very serious menace to the mutual welfare of both patient and operator (leaving the parent, for the time being, out of the question, although so very important and necessary), if one has under-estimated the time factor. Dissatisfaction must be the inevitable result of a miscalculation, with a consequent loss of prestige. This statement applies particularly to what is supposed to be a simple case, although I would suggest that a simple case is rare even if it ever exists, regarding it from the ideal standpoint. One's whole knowledge and experience must be enlisted at the initial stage to be able to give an approximate idea of this time factor. There is no knowledge at this initial stage of the temperament of parent, possibly most important, and child; no indication of trouble which may arise from unknown health conditions, both present and to come, and it is evident that any preliminary interview must have a forcible and marked effect on the attitude of those responsible for the upbringing and welfare of the patient. The foregoing remarks you may accept, if you like, as my apology for introducing the subject. I have endeavoured to avoid and evade the question openly of the economic side, but at the same time it will be ever present in our minds if I have presented my thesis as I hope to do.

My fears are that unless the public can feel a very definite assurance that orthodontic practice is a necessity, we shall make little progress except among those who regard dentistry as a serious and obvious attention, and can easily afford the treatment.

As a preliminary, may I quote from John Hunter the following words: "Don't ask me what I have written or what I have said, but ask me what I think now and I will tell you." These words imply a right to change an opinion upon fresh evidence or new facts being brought forward. It has been said that the man who never changes his opinion, never accomplishes anything. I am not sure of the accuracy of that quotation, but at any rate it embodies the ideas that I wish to give you to-night. So far as I

* *Transactions* of British Society for the Study of Orthodontics, 1934.

remember, we have had few, if any, papers which have dealt with the economic side of our work, and I know that it is distasteful and impossible to discuss these matters in a large assembly ; but so often one is asked questions of an economic type, both by patients and colleagues, and unless I am very stupid or so much out of things, I find there is an exaggerated idea in the minds of some of our professional brethren and our would-be patients, that orthodontic treatment is very largely a luxury, sometimes unnecessary, and that results can and should be obtained in a very much more simple fashion than we are in the habit of utilising.

It is somewhat distateful to me that the preliminary introduction to a consultation may be broached in an effusive and complimentary manner, and the inference implied that oneself is one of the very few who is capable of rendering the necessary service of correction. This always gives me an unconscious warning of troubles to come. I infinitely prefer to build up my parents' and patients' gratitude gradually, than to have it volubly and emphatically thrust upon me before we have any mutual acquaintance.

The difficulties in orthodontic practice do not lie only in the purely technical work, but also in the associated business and economic side of our work—involved as it is by our scholastic system, difficulties of referring patients at long distances for adjustments of appliances in cases where it is impossible for them to attend regularly, and very frequently a lack of appreciation after a time on the part of the parents in following up the necessary treatment to finally complete a case, and render it as perfect as possible. Initial progress may be very spectacular, and this once attained the parents assume, or may assume, that the work is ended. These are the cases that give us so much worry and anxiety, and so commonly are called " reversions " ; they are never thoroughly completed. We know that the practice of orthodontics is anathema to a great number of general practitioners, and yet they are expected to undertake treatment under the persistent request of the parents, on the age-long assumption that either in medicine or dentistry the practitioner is both capable and willing to undertake any treatments, however difficult and involved they may be. We know that this is not a practical solution of the problems, and the general practitioner, with so many variations of dental work in his daily practice, is unable to devote the necessary time at short notice to correct or adjust the appliance of a patient who may be sent to him in a casual manner. Nevertheless, one is grateful for the help that these men afford under the circumstances, and we should have some difficulty in carrying on our work without their help. It is obvious that the general practitioner must undertake orthodontic treatment. It is essential to the maintenance of his practice, and he may be well advised to eliminate the economic side and regard that factor as a non-earning or unprofitable side of practice.

What new bombshells are we to expect ? Involved as opinions are to-day, are we to be further encouraged or disheartened by any new facts or theses which Oppenheim is to give us in his new book ?

I might have entitled this paper, "Some of our difficulties in practice," but I do not wish to touch on the technical side, but rather to elicit from those of long experience some of their methods in dealing with the outside complications which arise. Over and above the conditions I have already cited, I think it is wise to give very considerable attention to the psychological side of our work. This attitude can only be gained from our experience, and I am always rather doubtful and a little bit pessimistic of the ultimate results when I have given a diagnosis and opinion to the voluble and effusive mother—who so often knows beforehand what is necessary to be done. I find her enthusiasm very largely reduced as time goes on, and people of this temperament are very often extremely impatient and expect wonders to be accomplished in a short time. The child frequently follows on with the same temperamental difficulties.

Again, I have always great hesitation in definitely allowing the time factor to operate in my mind with regard to the unusual but still fairly frequent type of child with a peculiar cold, light eye, of what I call starling blue or green type, which never enthuses or shows interest in the work one is doing. These are purely personal thoughts and experiences, but as one grows older, one is unconsciously perhaps inclined to make mental reservations in regard to these particular types of cases. There is, again, the impossible, turbulent, destructive child, and the careless and thoughtless child—very often the progeny of the same type of parents—careless with their appliances, either breaking or losing them, an utter disregard of prophylaxis and lack of general attention. This does not apply to any particular class, but may be as prevalent in the upper classes, as it is in one's hospital practice. The problem of the boy who must play rugger, box and "rag" is an ever present one.

One of the problems that causes me more anxiety than any other is that having given an opinion and having made a definite time contract, either verbally or in writing, it may be a more or less one-sided document or agreement. Whatever progress may be made, one is always diffident and anxious to avoid cessation of treatment from any of the foregoing causes. Having once embarked on the treatment of a case it is obviously, to me, an impossible position to ever consider ceasing one's treatment before completion. The result of any cessation can only recoil on the operator, and one is always very diffident of the accuracy of a statement that the child has been under treatment for so long with Mr. X, and the result of his treatment is either stationary, or the condition is even worse than when he started. It is always wise, I feel, to have a mental reservation in regard to those statements, as one so frequently finds, after a time, that one is being treated in the same casual manner that Mr. X had been treated. Therefore my own difficulties from this point of view are absolutely as great after many years of practice as they were when I first started enthusiastically to undertake it. There seems no way out, and while in ordinary business relations an agreement is steadfastly and rigorously upheld, in professional life it seems to

me that an agreement of this description mainly affects the operator. Perhaps some will be generous enough to outline their methods of dealing with these cases, which I imagine must be pretty general in everyone's practice.

I like to feel that I can eliminate any association of a business character with my work, once I have agreed upon the basis of that side of it, and then to build up a state of friendly and often affectionate co-operation with the child; thus gradually enlisting its help and creating an enthusiasm which ultimately results in a real gratitude and long friendship: and I can then regard the business side as a thing apart.

In 1932 I read a paper in which I endeavoured to bring forward the value that would accrue from the practical experience of many of the senior members of this Society, which by some means should be collated and passed on to the existing and future junior members of the Society. It seemed to me that, despite the value of many papers read during the year, there was no definite means of accumulating the practical side of our work in such a way that it could be handed on. I was somewhat disappointed to find that few junior members were present, and the senior members who were did not welcome my suggestions, as it would mean a tremendous amount of work on their part. I was told afterwards that the absence of the junior men was largely due to the title I had chosen for my paper, as it did not convey the points I had in view so clearly as I hoped it would do. The consequence is that nothing has evolved from my suggestions. Last November, Mr. Russell Marsh read a paper in which he appealed for help for the junior practitioners. This paper was received with great enthusiasm, due very largely to the way in which he presented it and the extraordinary amount of humour he managed to include in his suggestions and statements. The discussion disclosed the anxiety of the junior man to learn; he is not able to sacrifice any of his working time in acquiring the information he is so apparently anxious to gain. We have become accustomed here to listen to papers of great erudition and value, but many of them have a purely academic value and cannot be applied, or rather have little application, to the every-day practice of our specialty.

There is, to me, a danger in the wonderful evolution of the technical skill shown in the practical side of our work. The tendency seems to be to evolve beautiful pieces of mechanical work, complicated frequently in their ingenuity, which may or may not attain the desires in a practical way of the designer, or in his or her hands may be entirely efficient but, on the other hand, are quite impossible for the beginner to understand and use. I often feel that the simpler the method employed, the more valuable it must be to the great body of students. Therefore I come to the problem of "Time" in the practice of orthodontics, and when I use the word "Time" I wish it to express more than the passage of months or years, and to contain within that word the other considerations that are so important and necessary in our practice. In the word "Time" I wish to include, mentally, the condition that will be generated in the mind of the parent, the difficulties

that are to be overcome by the operator, and the economic factor that has to be seriously considered both by parent and operator ; thus " Time," in the sense in which I am using it now, means the amount of service and the cost to the operator and the parent, and so rather than have to talk about fees, length of time of treatment in months and years, I want to try and establish in your minds that the simple word " Time " includes all these.

May we for a moment imagine that we are in consultation with a very complicated case in a child of seven years. At once it is realised that there must be five or seven years' constant supervision before one can definitely say, " this case is completed." The loss of temporary teeth and replacement by the permanent ones, the actual mechanical treatment to render the equation perfect, must carry one through to the time when the permanent teeth are all in position. If at the initial stage the parent is told that this is a condition which needs more or less constant observation and treatment for seven years, it is to the average individual an appalling suggestion. If, on the other hand, the patient should be nine or ten years of age, that question of time is reduced by a natural reduction in the time of completion of the dentures.

Now, how are we to overcome, and what methods can we employ, to satisfy the parents and ourselves as to the best explanation of the difficulties involved in the treatment of these cases ? Personally, I do not know. Time tells me that the more experience gained, the more critical and the more exacting requirements may be, and it is difficult to bring oneself down to the mentality of the average parent and accept their suggestions—often so volubly given. From our point of view we have to decide what is to influence us, not so much in an individual case, but in the general attitude to the subject of the average parents. It is practically an impossibility to convey to the average parent all that is conveyed in the word " Growth," whether this be normal or abnormal. It seems to me that in England we have a conglomeration of the post-normal, or distal, occlusions. We have not educated our people in dental anomalies. In America, it is possible that they have better material on which to work, a very thorough and sincere dental education of the public, and that our dominant post-normal condition does not exist to anything like the same extent. It is quite obvious that treatment of a great mass of malocclusions in our population, with the idea of developing a perfect occlusion, is out of the question. The time factor alone renders this impossible.

How can we approach this subject both from parents' point of view, the child's benefit, and our own difficulties ? The dental schools are able to give only a little help. In the teaching of the students a certain number of cases are demanded for treatment in their curriculum. This in a thickly populated neighbourhood only touches the fringe of the problem ; therefore, the young practitioner has had very little opportunity of studying the subject seriously, and upon qualification is very ill-equipped to deal with the problems that will present themselves. What is the remedy ? So far I can see nothing more than an occasional desire to acquire

the necessary skill which only time can give, and during this probationary period, serious mistakes may be made which may materially affect the future career of the student, and his enthusiasm may be dulled.

The ever-present economic factor which has been so dominant during the past few years, must be recognised as a very serious menace to our work, and I have observed during this time that there have been many cases in which I have been consulted in which anxiety of both parent and dentist to undertake treatment has been present, and the outcome of consultations has been more or less negative. I could quote you many cases to illustrate this particular point, but I think one interesting case will make my point clear. A girl of 14 with a very pronounced post-normal occlusion was brought to me for an opinion as to treatment. It shows how varied can be the attitude of parents and practitioners. In this case we had an anxious mother, an unobservant father, and two opinions which were diametrically opposed. In the one case, treatment was advised which did not include extraction ; in the other, treatment was advised which included extraction. My own opinion was that the first advice was correct. Here the economic factor came in. Although in a very good social position, the parents were poor. The second treatment, involving extraction, was to be carried through at a fee which could not in any way show any recompense for the work necessary ; and the first treatment, which did not involve extraction, was to be carried through at a lesser fee. This was purely a personal matter, but the result of my consultation was so definite that I advised the parents to accept the offer of the first treatment. It was so entirely impossible from my point of view that any man who knew what was necessary could undertake this work with any prospect of success and financial satisfaction to himself, at the fee quoted, that I could only feel he had no knowledge of his subject and would regret ever having undertaken the case. Time will prove whether I am correct in my diagnosis of the general economic situation. This is only one illustration of many that one comes across.

It must be within the knowledge of many senior members of this Society that their help is requested after parents have spent much "Time" without any apparent results, and have become hopelessly disappointed at the possibility of any benefit ever accruing. This is, I feel, placing before you an entirely new attitude with regard to orthodontic treatment, but I feel it is an extremely important side to our work and can do far more harm to our specialty than any amount of good work, because it is so obvious that failure must always be far more advertised than success. Some two years ago, the parent of an American boy of 14 was introduced to me by a general practitioner for my opinion, and with the hope that I would be able to help her in introducing her to a Continental orthodonist, who would be able to continue treatment for her child who was going to school on the Continent. In conversation, I discovered that this child had been under treatment since he was seven years of age at a fee which would stagger even the most exclusive orthodontic practitioner in this country.

There was no evidence of dissatisfaction on the financial side, or in the treatment, and I could not see how any amount of further treatment could accomplish the ideals of my American colleague. The occlusion of the posterior teeth was perfect; there was no caries after all this treatment; the mouth was perfectly healthy, but the right upper canine was still completely outside the arch, and I could not see how it was to be placed into position. After a long consultation, my advice was to remove the first premolar and to allow the canine to be drawn into position. This, of course, entirely subject to the opinion of the man to whom I sent her. This opinion was given in response to a definite request. I wonder how many English parents would still regard the matter with the complacency of this American parent, after seven years of active treatment.

There, I grant you, we are dealing with a somewhat unique case. In this country we have to deal with people who have not that wealth or possibility of rewarding us to anything like that extent. And so I think that behind the very constant advice that is given by the general practitioner, the great benefit of extraction to the child and the parent will accrue in this matter of time. To the orthodontist, the problem is without exception the most serious one he has to decide; so many factors have to be considered in this diagnosis. One has to acquire or develop a sense of the possibilities in regard to the child's physical development. On which side is it to develop, the paternal or maternal? Is it a throw-back? Can one gather any help from any of the family records. In many cases they are non-existent; and it is this weary time of waiting for development of a tardy eruption of individual teeth in a young child that so tires the parties concerned, and it is quite understandable that a busy man in general practice will find himself gradually disinterested in a case that shows no response to his treatment. These things are difficulties that exist for everyone practising dentistry, and they exist for the orthodontist just as much as the general practitioner, but when one is doing one job it is quite possible that what is insuperable to the general practitioner is of ordinary accomplishment in the hands of the skilled orthodontist.

In putting before you this evening some cases which have been completed, I am doing so with the idea of showing the "Time" involved and not the methods. I feel we shall be giving greater service in this country, at any rate, by a catholicity of method rather than by a reservation of technique. Whilst your criticisms will probably be directed to a reduction of the time factor in some of the results I am showing you, I ask you to reserve that criticism of the existing conditions obtained and to throw your minds forward to the possibilities that may arise after the completion of treatment. I feel that more serious consideration should be given to the question of extraction after completion of treatment than before or during that treatment. By this I mean that if one is given the opportunity to correct a malocclusion, one must look to future possibilities of having the correction again upset. This comes about through what I feel is an ever-increasing abnormality—the

impaction of the third molars, and it is becoming my constant practice to take every care in observation that the third molar shall not be a possible factor in the derangement of any work I have accomplished. In regard to this, I have expressed an opinion in correspondence with some of my American friends that the removal of the second molar may be a wise proceeding where the third molar shows any abnormality of position. I was rather interested by the suggestion of one eminent American practitioner, to which I have not yet replied, that the malposition of the third molar in the States did not afford them any anxiety, as they had many skilled exodontists to whom this factor presents no difficulties.

At this point, I have saved no time in the broad sense. My case is completed anteriorly, and my safeguards are only the prevention of future trouble.

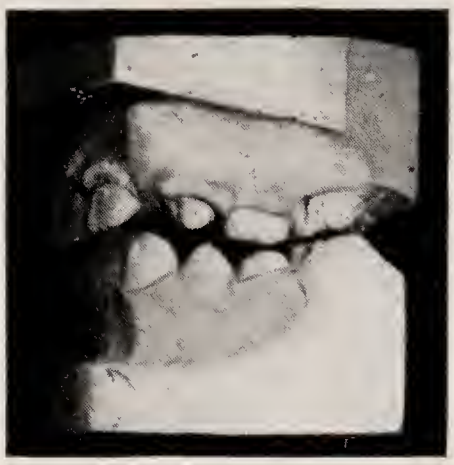
During my student years it was customary to remove the four first permanent molars if there was evidence of caries or anterior crowding, and this treatment was only stopped when Angle evolved his theory of the possibility of retaining the full complement of teeth. Following upon this treatment in those days one had little evidence of troubles of impacted molars. Radiography was in its infancy, and I think I should be correct in saying that it is well within the last twenty years that this third molar problem has presented the difficulties with which we have to contend to-day, and it seems to me that we must look to some provision of space in the molar region to overcome these difficulties. This, therefore, is my thesis : it does not relieve us from all our troubles in correcting anterior malocclusions. Thus we are again thrust back to the " Time " factor. The removal of first upper premolars, which is so constant a practice, and which, as one notes in the great majority of cases, must not be accompanied by removal of their fellows in the mandible, gives no help in this problem of impacted lower molars. So we are driven back again on to the hard rock of experience and we have to make our decisions on the individual facts before us, and so often we have to give our advice on this " Time " factor, and my appeal is that the " Time " factor should have and bear a very great responsibility in our attitude to the advice we give.

My desire is to straighten out some of our important difficulties, and if possible arrive at an understanding which may help us to overcome them. I realise they are of a personal character. Am I too optimistic ?

Acknowledging the conditions which I have enumerated, it does seem unjust and at times impossible to obviate the cessation of treatment, but if that must arise, then there should be some method of placing on record the real facts ; and it should not be possible or expected that the onus of completion should be placed on the orthodontist who has a conscientious objection to being left in the lurch.

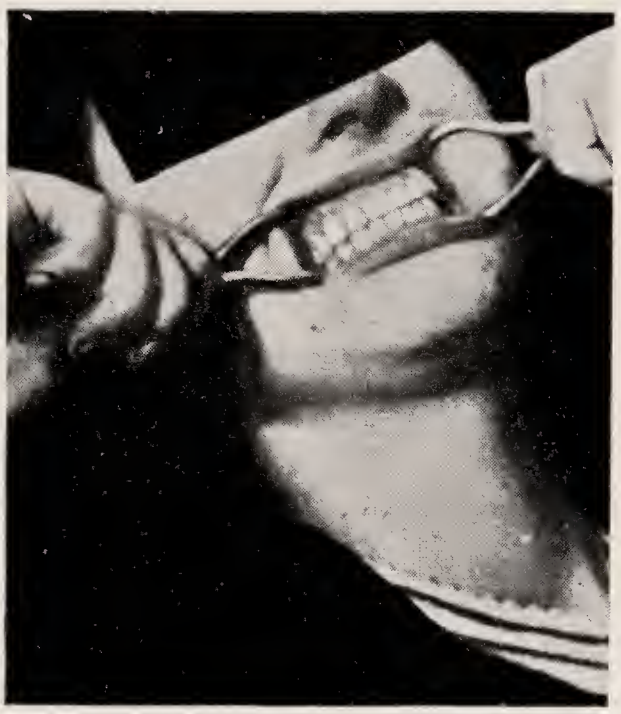
You will have seen from the slides how variable my time estimate has been—very markedly on the short side. The cases which could be recorded where the time was less than the estimate, would be

Mr. Cale-Matthews' Communication: Some of the Slides Shown.



A 1.

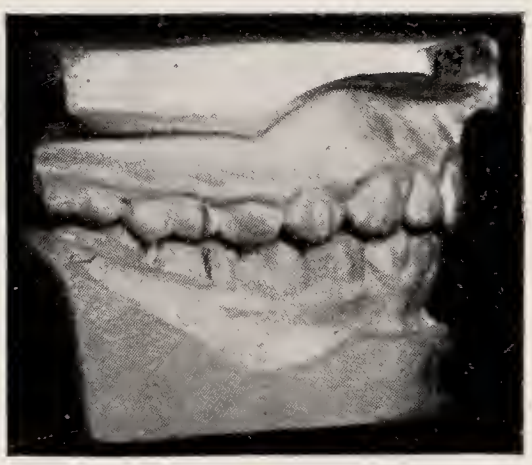
A 2.



A 3.

A 1, 2, 3.—æt. 8–4/12. Bilateral post-normal. Slow eruption of $\underline{3}|\underline{3}$. Completed and under retention. Estimated originally two years to restore normal occlusion. Actual treatment and preliminary retentions five years. Any suggestion of extraction would have been seriously resented.

B 1.



B 2.

B 1, 2.—æt. 13. Good occlusion. Upper incisors proclinated. I regard this as difficult type of case. Estimate two years. Actual time ten months, when retentions were placed. Error on the right side of time.

C 1.

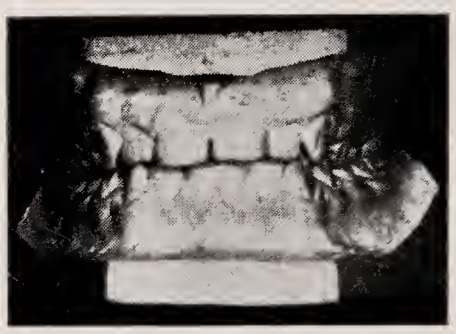
C 2.

C 3.

C 1, 2, 3.—æt. 9-8/12. Good occlusion. No space for $\overline{3|3}$. Estimate two years. Actual eighteen months. Difficult to handle and no enthusiasm.

D 1.

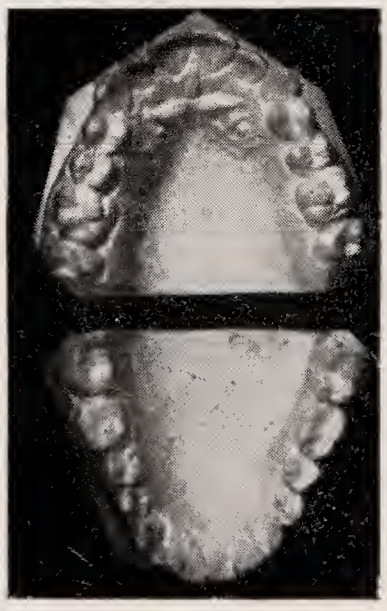
D 2.



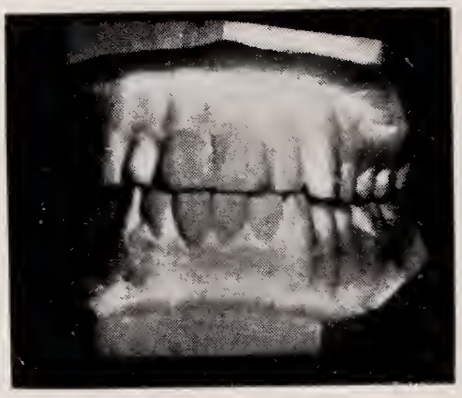
D 3.

D 1, 2, 3.—æt. 8–5/12. Time estimate two years, with reserved opinion based on eruption of premolars. Treatment directed to establish correct occlusion without interference with incisors. Illness or operation greatly delayed treatment. Actual time four years. Two years on wrong side.

E 1.



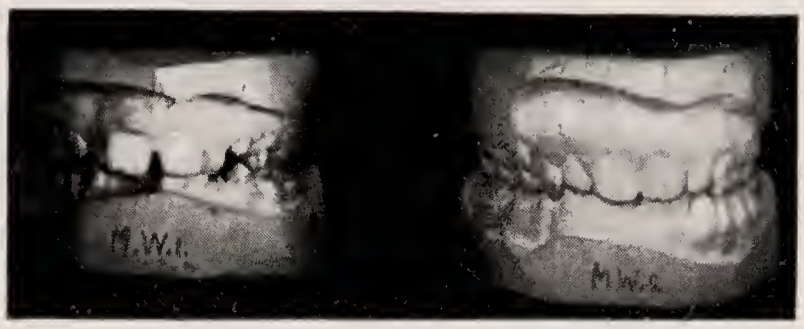
E 2.



E 3.

E 1, 2, 3.—æt. 13.—Normal occlusion. General narrowing in anterior part of both maxillæ and mandible with marked crowding. Estimated time up to two years. Actual active treatment nine months. Fifteen months on the right side.

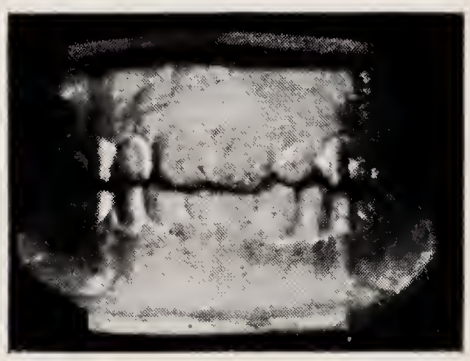
F 1.



F 2.

F 1, 2.—æt. 12. Premolar extraction. No treatment prescribed. This quickly resolved itself under treatment and no time estimate given. Actual holiday visits covered one year nine months.

G 1.

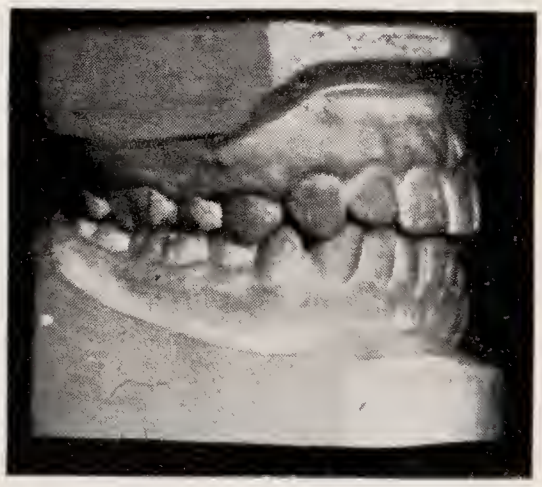


G 2.

G 1, 2.—æt. 10. No time estimate. Hopeful to get results on complete eruption of second molars. Actual treatment two years seven months. Third molar interference is developing.

H 1.

H 2.



H 3.

H 1, 2, 3.—æt. 8–7/12. Bilateral post-normal. Many difficulties arose in course of treatment. Delayed eruptions and only holiday treatment possible. Actual time elapsing between first and final models five years nine months. A time estimate would have been sadly upset.

I 1.

I 2.

I 3.

I 4.

I 1, 2, 3, 4.—æt. 14. Unilateral post-normal. $\overline{5\ 4}\,|\,\overline{4\ 5}$ out of alignment. Open bite. Occlusion established. $\underline{3\ 2\ 1}\,|\,\underline{1\ 2\ 3}$ lengthened. Case under retention. Time estimate two years definite contract. Started October 31. Exceeded estimate, when retention was placed, by three months. Under constant observation.

J 1.

J 2.

J 1, 2.—Bilateral post-normal. Excessive growth of maxillæ. No time estimate. Actual treatment a little over two years.

considerably less. Can judicious and well-judged extractions shorten our treatments to any extent ? Undoubtedly, in cases of true superior protrusion, it can do so, but I can see little hope that it will do so in cases which demand a complete movement of the mandible to render the occlusion perfect and restore a facial contour which is pleasing.

If we are content to leave post-normal occlusion and only correct anterior prominence, then extraction can shorten the time estimate, but that is another story, and discrimination can be a factor if brought to a fine art.

Discussion.

Mr. Bulleid said that Mr. Cale-Matthews was to be congratulated on his paper, which was one that would cause them furiously to think. Of course, he rather invited them to be prophets, and the prophet's job was a very thankless one at any time. When the question was put to himself " How long will treatment be necessary ? " his usual answer was, " I will tell you in about six months' time." One really could not say at the beginning how a case would go, or with what speed treatment could be accomplished, until one had had some experience of the particular case in hand. After six months one was in a better position to give a tentative estimate than at the time of starting. At any rate, that was the subterfuge, if one liked to call it so, which he used in speaking to parents in order to safeguard himself. There were two other vital factors, as the author had pointed out, which needed to be taken into consideration. One of these was the age of the patient. Was it ever safe to say that a case was complete until the bicuspids had been erupted for at least twelve months ? He would hesitate to say so. Another point that must be kept in mind was that if the child was a very young child the case was likely to be longer than if the child was aged ten or eleven. The time of eruption of the bicuspids was the optimum time for rapid treatment. Even if one was dealing with a very young child, one could say, " Well, we can carry out certain preliminary treatment which will take, say, twelve months." He had in mind that a very large number of cases where the condition with which one had to deal was a lack of alveolar development in the posterior part of the mouth. With twelve months' use of a bite plate it was astonishing, as they all knew, how a case which apparently was hopelessly complicated, simplified itself. Often the arches appeared to broaden themselves, and, at any rate, the case greatly improved, if nothing more. Again, one had to take into account the hereditary factor. If the child was obviously developing a condition which one or other of the parents showed, one must be far more conservative than when dealing with a case where a hereditary factor was not apparent. In these hereditary cases one should not give an estimate of time required, or even an absolute prognosis, as one might do, say, in a condition which was the result of vicious habit. The abnormal growth factor was so strong that it was a question whether an ideal result would ever be attained. All that one could say in these hereditary cases was that one would do the best possible. It might be politely intimated to the father or mother, as the case might be, that they themselves were really to blame, and that the orthodontist could only do what was possible in the circumstances. If he offered to do more than that it was very possible that he would get into deep water. As he had stated, the part of the prophet was a very difficult one to fill. He never gave a time limit before six months have elapsed. As for the

fee, on which the author had asked their opinions, that was a matter which had better be arranged with the parents, and he did not think it was one into which the Society could enter. He could only give the manner in which he in his own imperfect way practically "hedged" over estimating the time of treatment.

Mr. L. Russell Marsh said it occurred to him that in bringing forward this consideration of the time factor the author had rather emphasised that if they had a child six years old for treatment they had to say to the child's parents, if they were to be perfectly honest, that the treatment would take the best part of eight years. This was because they could not be sure that the treatment was completed until the premolars were fully erupted. If that statement were made to the parents the result would be quite probably that they would go somewhere else for advice. Therefore the question resolved itself into doing some preliminary treatment in the early years and letting the case rest, and then undertaking further treatment. It would be useful to know whether in Class II cases, they were going in for maxillary retraction or extraction. If the former, the earlier they started the better. If extraction were decided on, the ultimate treatment could not be started until the premolars were erupted. That period in between the preliminary treatment at the early age when the child first came forward and the later age when one was going to do, presumably, extraction treatment, say at about eleven or twelve, was rather a difficulty. He heard a somewhat cynical story a little while ago, which might be considered a parallel to that situation. A man was reading a paper on cleft palates, and definitely proved to his audience that a cleft palate should not be treated surgically during the first few months of life as had been the practice in the past. Most of the surgeons were more or less agreed, at least from the dental point of view, that if cleft palate were treated before the age of five years there was likely to be a condition of chaos in the dental arches. Later, however, this same lecturer approached one of his surgical colleagues and asked him at what age he was treating cleft palates. The answer was, "Six months." "But did you not agree," the other asked, "that it was better not to begin treatment until the age of five?" "Yes," was the reply, "but if I do not do it at six months someone else does!" The author had brought up the question of the anxious mother and the unobservant father. That was a difficulty which one was often up against, namely, a state of affairs in which the father, who was responsible for paying the account, was not anxious about having the treatment continued, while the mother desired it to be done. The orthodontist in such a case was up against opposing forces, and if unfortunately his treatment did not seem to be going on rapidly he was likely to be criticised by the father and by others on that side of the family. He himself had had one or two cases in which the father was definitely opposed to the treatment, while, on the other hand, the mother was bringing the child for treatment. This placed the orthodontist in a very difficult position. Among the cases which the author had shown, he noticed that those in which he had over-estimated the time factor—in other words, those in which he had managed to complete treatment earlier—were all cases in which the child was getting on towards twelve years of age when treatment started. With the younger children it was always a question of under-estimating the time. He believed that this was the first occasion on which he had heard Mr. Cale-Matthews even tentatively defend extractions. When the time factor and fees were concerned one had to present the parent with alternatives, on the one hand a long treatment which would cost money, and on the other hand what the parent might describe as a second

class treatment which would produce fairly good results in a short time and be less expensive.

Mr. HENRY said that he belonged to the anti-extractionists. Nevertheless, he realised that in some cases, conditions were such that, when the age of the patient, the time factor, and the difficulties of the case were considered, extraction might become necessary. In the case of young children when the teeth were in post-normal occlusion at seven or eight years of age, he always told the parents that they would need active treatment for a certain period in order to get the arches into proper relationship. Then came a period of observation until all the permanent teeth had appeared. In that way he did not have to frighten the parents by saying that treatment would extend over several years. There were certain cases where the teeth would not respond normally to tooth movement. He had had two cases like that. The teeth erupted, but although there was space for them, they could not be moved into that space, except by abnormal pressure. He was in America in 1932, and visited many colleagues there, some of whom showed him similar cases and said : " Have you come across anything like this where the teeth will not move ? "—that is to say, cases where they could not get any expansion in the usual way. He therefore felt that when they encountered such a case and could not get results, it might well be due to the non-responsive nature of the teeth.

Mr. A. T. PITTS said that Mr. Cale-Matthews had raised many controversial points on one or two of which he would like to comment. With regard to the time factor in treatment and what should be said to parents, he felt that the important thing was to make clear to them that part of the time would be devoted to actual treatment and a part to watchful supervision. If a parent was told that treatment would last up to twelve or thirteen when the second molars were through, he might get the impression that all this time would be taken up with making and wearing a constant succession of appliances and not unnaturally, might become alarmed. But if it were put that the responsibility of the orthodontist lasted for so many years, but that actual treatment only occupied a part of this time, then the matter was put in a better perspective. His own feelings were that in all the gross forms of malocclusion the responsibility of the orthodontist quite definitely went on until the second molars were fully in place. If, for instance, in a case of post-normal occlusion treated by an inclined plane or intermaxillary traction, stabilisation had not taken place by the time the second molars had erupted, then he doubted if permanence would ever occur. Mr. Cale-Matthews had referred to the menace of the third molars. He was glad to see that Mr. Cale-Matthews had altered his views on this subject. Several years ago he remembered hearing him express the opinion that the eruption of the third molars tended to lock the arch and prevent relapse. Evidently he held that view no longer. He, the speaker, was of the opinion that the position of the lower third molar was extremely important in regard to the prognosis of the treatment of crowding. He had seen many cases which he had regarded as completed. But when some of these children had reached the late teens he had noticed some relapse evidently due to the pressure from behind of the erupting lower third molar. This was particularly likely to happen in those cases of crowding treated by expansion where room, but only just enough room, had been obtained. The result looked good at the age of, say, thirteen, and remained so for a time. But the slow pressure of the lower third molars even if not misplaced, would be very likely to cause some relapse especially in the incisor region. In several cases he had removed a premolar on each side some time after he had completed the treatment, so as to

break the line of pressure. This was an aspect of orthodontic treatment which had to be worked out more fully and to receive a greater recognition in the future than it had received in the past. In his innocence he had thought that the paper was going to be devoted chiefly to the question of the time factor in relation to extraction in the treatment of malocclusion. But evidently he had misread the title for they had heard singularly little about the extraction of teeth. It appeared to him that Mr. Cale-Matthews took up the attitude that while the extraction of teeth might offer an inferior short cut where time was of real importance, yet where the arches wanted careful re-modelling, extraction was not good treatment. With that view he disagreed. He found that he carried out the extraction of teeth as part of the treatment of irregularities in an increasing number of cases. Looking back on his practice he could remember many cases where afterwards he had regretted not having removed teeth. He could not recall many cases where he had been sorry that he had extracted teeth save in some cases where he had removed a lower incisor and had found subsequently a collapse of the arch in front. He did not regard extraction as a second best form of treatment. In those cases where he thought extraction was called for he carried it out irrespective of any economic or other factor as being the form of treatment likely to give the best and most permanent result.

Mr. Robert Cutler said with regard to the time factor that if one saw a child of seven or eight and the parents asked how long the case would be under treatment it was quite a good thing to explain that the appliances themselves were of no intrinsic value, but that all they did was to influence bone growth. As growth obviously went on to the age of thirteen or fourteen, appliances of one sort or another which would direct the growth of bone were necessary just as the gardener directed the growth of a creeper by means of sticks and string. It was well to explain to the parents that the appliances merely guided the growth processes into normal channels. He proceeded to say that the point to which Mr. Pitts took exception in the author's remarks about extraction in post-normal cases was purely a difference in point of view. Mr. Cale-Matthews had been concerned to point out the temptation in some post-normal cases to snatch an easy victory. Often in such cases, if one saw the patient two or three years afterwards, even though the parents professed themselves pleased with the result, one felt oneself rather like "Iscariot with his bag of gold," because one knew what could have been done if one had not taken the easy path and got a result which pleased the parents in a relatively short time. With regard to the over-anxious mother and the unobservant father, the father being unwilling to meet his commitments, he himself had always thought that if the mother was sufficiently anxious, the father would sign unlimited cheques, if only to secure peace and quiet in the house!

Mrs. Muriel Michaelis asked whether Mr. Pitts had taken into consideration the extreme difficulty in practice of persuading parents to allow extraction. The parent usually insisted on the retention of the teeth and would not allow the child to miss any teeth at all.

Mr. Cale-Matthews, in reply, said that the members had treated him more generously than he had expected. He had felt very diffident in introducing this subject, but he considered that someone should say these things, pointing out that orthodontics was not all a question, as Friel said on one occasion, in scathing terms, of "tooth pushing." Of course, there was a sense in which orthodontists were only "tooth pushers" after all, whether they liked it or not. The general question seemed to turn upon whether they were going to be philanthropists

and practise orthodontics for their "health," or be like the average general practitioner in dentistry, who obviously and quite honestly was out for his livelihood. What he had wanted to get as a result of his paper was the experiences of those present. Mr. Pitts was perfectly straightforward. He was not an orthodontist, in the sense that he did not rely on his orthodontic practice entirely, and consequently he did not perhaps get the extraordinary difficulties of decision which the orthodontist pure and simple encountered. Anyone continually treating his own patients, not patients which had been sent to him by some other practitioner who might himself have started or delayed starting treatment, and expected the orthodontist to attain the sometimes unattainable. Further, having started with the ideals of an orthodontist, it must not be imagined for one moment that the orthodontist did not put before the persons concerned the alternative treatment. These matters applied mainly to children who were perhaps the children of wealthy people, or at any rate, of people who aspired to a certain social position for their children when they were grown up. They resented the idea of any form of treatment that involved the loss of the natural teeth. Further than that, he wished again to have an opinion for their mutual benefit as to this factor of responsibility—on completion. Many of those present must have had the same experience as himself, in which, if one was willing to carry on one's contract, one might have to continue the treatment under arbitrary conditions for a very much longer period than was allowed for in the original diagnosis. Among parents, of course, one got a very large number of quite reasonable people, but occasionally one came across unreasonable people who made demands, courteously or otherwise. In these cases the orthodontist was placed in a very difficult position, and his object that night had been to endeavour to find out what the experience of some of those present was in regard to broken contracts where one had definitely estimated the time factor, and found oneself unable to do so within the specified period. He was pleased that so many members had given their views. Mr. Bulleid was quite right in the opinions he had advanced. One went on as well as one could. If one was dealing with one's own patients, again, having their confidence, one could explain matters to them from time to time. But if they were patients of some other practitioner the difficulty was increased. The point he had made about extraction was this, that he would rather extract after a certain amount of treatment or even after the apparent completion of a certain type of treatment, than at the beginning of a treatment. In other words, in an obstinate condition of post-normal occlusion, if he failed after a certain time to obtain a normal occlusion, not due to any anatomical condition, but to a definite lack of co-operation on the part of the patient, then he thought he would be prepared to remove the upper premolars and draw back the whole of the anterior teeth. But to start out one's treatment by extraction, when one had the opportunity of acquiring the ideal condition, was a course with which he could not agree. Mr. Marsh had followed somewhat on the same lines. He knew that Mr. Marsh had a very broad outlook on this subject. He pointed out quite clearly that one had to decide definitely as to whether extraction was to be the main part of one's treatment or whether one was to carry on for prolonged terms in active mechanical treatment. Mr. Henry he called a "die-hard" simply because he was, like himself, much engaged in the orthodontic ideal which originated with Angle, but had gradually come to the conclusion that it was an impossibility. The speaker believed that the ideal was more of an impossibility here than on the other side of the water. He had mentioned in his paper that they had plenty of exodontists in America to

whom the third molar was said to present no difficulties. But the question of third molar eruption was a very serious one, and one of ever-increasing difficulty. Mr. Pitts had again raised the question of extraction. The speaker really thought that it was a matter of the position in which one found oneself. It would be very desirable if they could talk frankly to one another sitting around a table, rather than discuss these matters under the restraints necessary in a scientific assembly. If that were done they would be far more helpful. The question turned again largely on the difference between the man in general practice and the man who was exclusively an orthodontist. Supposing that one had to see during one's day's work ten or a dozen children, passing from one to the other. The work might become on certain days almost a mechanical routine, a few minutes being spent with one child and an hour with another. But in the case of the man in general practice conditions were quite different. He was required with each case to dissociate himself absolutely from what he had been doing just before. He might see only one child in a day, or perhaps two or three, and he had to pick the thing up anew every time. The technique and methods of orthodontic practice were altogether different from those of general dental practice. He was quite willing to admit Mr. Pitt's accusation that on the point mentioned he had changed his mind. He remembered the occasion quite well to which Mr. Pitts had referred, when he (the speaker) had said that the third molars were the final corner-stone of perfect dentition. He had not altered his opinion there, but he thought where there was any evidence of those teeth interfering with the correction that one had made, then either they or the anterior teeth should be removed. He was not original in the idea of removing the second molars; it was advocated by some American orthodontists ten or fifteen years ago. Like Mr. Henry he thought Mr. Cutler's illustration was extraordinarily good, and he liked his idea.

REPORTS OF TWO TREATED CASES: PRESENTATION OF THE PATIENTS.*

By Harold Chapman.

London Hospital, Case No. 387. F. Age 9–7

Shown on February 5th, 1934.

Diagnosis:

Arch-relationship: right side normal (tends to be pre-normal); left side, lower pre-normal.

The facial appearance confirmed the diagnosis that there was pre-normality of the mandible. The diagnosis is complicated by the fact that | D has been lost prematurely, and the space for it closed by distal movement of | 12C and medial movement of | E6: there is flattening of the upper arch in | C region.

The lower arch is good except for some abnormal tooth movement as a result of caries of | D.

When allowance has been made for these local conditions there is little doubt that the mandible was pre-normal on the left side.

21 | 12 are in lingual occlusion, except the distal corner of 1 |.

* *Transactions* of British Society for the Study of Orthodontics, Feb. 5th, 1934.

Treatment :

It was decided to attempt to retract the mandible without inter-maxillary traction, and this has occurred (as demonstrated by the occlusion of the first permanent molars) on the left side and to a less extent on the right side, though no provision was made to treat one side differently from the other. The distance from $\underline{|\,2}$ mes. to $\underline{|\,6}$ mes. is also greater, probably because the teeth are now on an almost straight line, whereas they were on a curved line previously.

The change was brought about by :—

(1) An inclined plane on the lower incisors worn for $4\frac{1}{2}$ weeks, October 20th, 1933, to November 21st, 1933.

(2) An upper saddle vulcanite plate with springs (also spur to keep the latter in position), to move $\underline{21\,|\,12}$ labially ; all metal parts stainless steel ; worn from October 20th, 1933, to January 30th, 1934, when the teeth were in good relations ; plate still being worn to retain the teeth in their new positions.

(3) Chin cap and head cap, with traction applied by rubber bands to retract the mandible ; worn for three months—continuously—October 20th, 1933, to January 30th, 1934, and from that date, at night only, so long as there is no relapse.

(4) The child endeavoured to bring her lower incisors behind the upper ones ; a definite effort to do this was made twenty times, three times a day.

Further treatment will be to correct the alignment of $\underline{1\,|}$ and the removal of an upper premolar.

The excellent result obtained up to this point is undoubtedly due to the wholehearted co-operation of the patient and parents.

Two valuable sets of data have been omitted :—

(i) Photographs.

(ii) Radial measurements from the external auditory meatus ; these would have confirmed the changes resulting from treatment.

LONDON HOSPITAL, CASE NO. 286. F. AGE 14–0
Shown on February 5th, 1934.

Diagnosis :

Arch-relationship : right side normal (or slightly post-normal) ; left side post-normal. Upper and lower incisors considerably apart in the horizontal direction. Mouth and gums in very poor condition ; the latter were spongy, turgid and inflamed.

Treatment :

Upper. $\underline{2\,|\,2}$ extracted at age 12–10, and $\underline{1\,|\,1}$ retracted, and also moved to the left to give more room for $\underline{3\,|}$. A plate for this purpose was put in on June 14th, 1932, age 12–11. The teeth were in good alignment in June, 1933, age 13–11, when the upper plate was discarded, and the patient has not worn an upper appliance since. $\underline{1\,|\,1}$ are remaining in position remarkably well, there being only a slight relapse in six months, which may be seen

by comparing model 286A with the actual case. $\underline{3 \mid 3}$ have narrowed 4.5 mm.; $\underline{54 \mid 45}$ no change.

Lower. $\mid \overline{1}$ extracted, age 12–10. There was no lower treatment, but on June 13th, 1933, it was found that the lower canine region had narrowed by 3 mm., so a plate was given to wear at night only to prevent this going further. That plate is now being worn five nights a week. It is now a question whether $\overline{4 \mid 4}$ should be removed and $\overline{3 \mid 3}$ retracted. The patient has derived great benefit from what has been done.

SOME NOTES ON NORMAL OCCLUSION.

By Harold Chapman, L.D.S.Eng.

Examples of normal occlusion, in the case of two sisters, are shown in Figs. 1 and 2 ; the legends are written as part of the text ; it is not intended to point out all the changes enumerated by Friel.[5]

Fig. 1.—Normal Occlusion. (No treatment.)

The occlusal relations of all the teeth of one side and the changes in those relations cannot be shown in two photographs ; hence separate series of photographs are necessary to show canine relations (Fig. 1*c*, *f*, *k*, and Fig. 2*e*, *f*) and molar relations (Fig. 1*d*, *g*, *m*, and Fig. 2*c*, *d*).*

The vertical lines on the teeth are drawn through the same point (from the triangular ridge of the medio-buccal cusp of $\underline{E \mid E}$ and in the buccal groove $\overline{E \mid E}$) in each case to enable the reader to see at a glance the change in the medio-distal relations of the teeth : the marked surfaces are neither vertical nor parallel to one another ; this also leads to difficulty in reproduction, but every care has been taken to show as accurately as possible what may be seen on the models.

(*a*) Age 5–7†. Occlusal view. Spaces between all upper deciduous incisors, also behind upper and lower canines. Very little or no attrition. $\frac{6 \mid 6}{6\ 1 \mid 1\ 6}$ erupting. Breadth‡ $\underline{C \mid C}$ (cusp points), 30 mm.

(*b*) Age 5–7. Right side to show $\frac{E \mid}{E \mid}$ occlusion. $\overline{E \mid}$ buccal groove distal to cusp point and triangular ridge of medio-buccal cusp $\underline{E \mid}$ (*cf.* Fig. 1*d*). This difference on the two sides persists until age 9–5, but $\frac{6\ C \mid}{6\ 3 \mid}$ appear to be in normal medio-distal relations. No models later than age 9–5 available.

(*e*) Age 6–9. Occlusal view. Spaces behind all deciduous canines closed. $\frac{1 \mid 1}{2 \mid 2}$ erupted. $\underline{1 \mid 1}$ spaced 3 mm. No noticeable increase of attrition. Breadth $\underline{C \mid C}$ (cusp points), 33 mm.

(*h*) Age 9–5. Occlusal view. $\overline{3 \mid 3}$ have erupted ; $\overline{4 \mid 4}$ are erupting ; spaces between upper incisors ; but that between $\underline{1 \mid 1}$ is now only 1 mm. ; spaces between $\underline{C\ 2 \mid}$ and $\underline{\mid 2\ C}$ (*cf.* Fig. 4) ; all these spaces will be closed when the permanent canines are in position. No noticeable increase of attrition. Breadth $\underline{C \mid C}$ (cusp points), 35 mm.

(*c*) Age 5–7. Left side to show $\frac{\mid C}{\mid C}$ occlusion. The tips or

* Suggestion of Dr. Sheldon Friel.

† Age 5–7 means 5 years 7 months.

‡ As, in the report [8], the term "breadth" is here used to denote the span across the arch ; the term "width" is used to indicate the extent of a tooth from side to side, whether bucco-lingually or medio-distally.

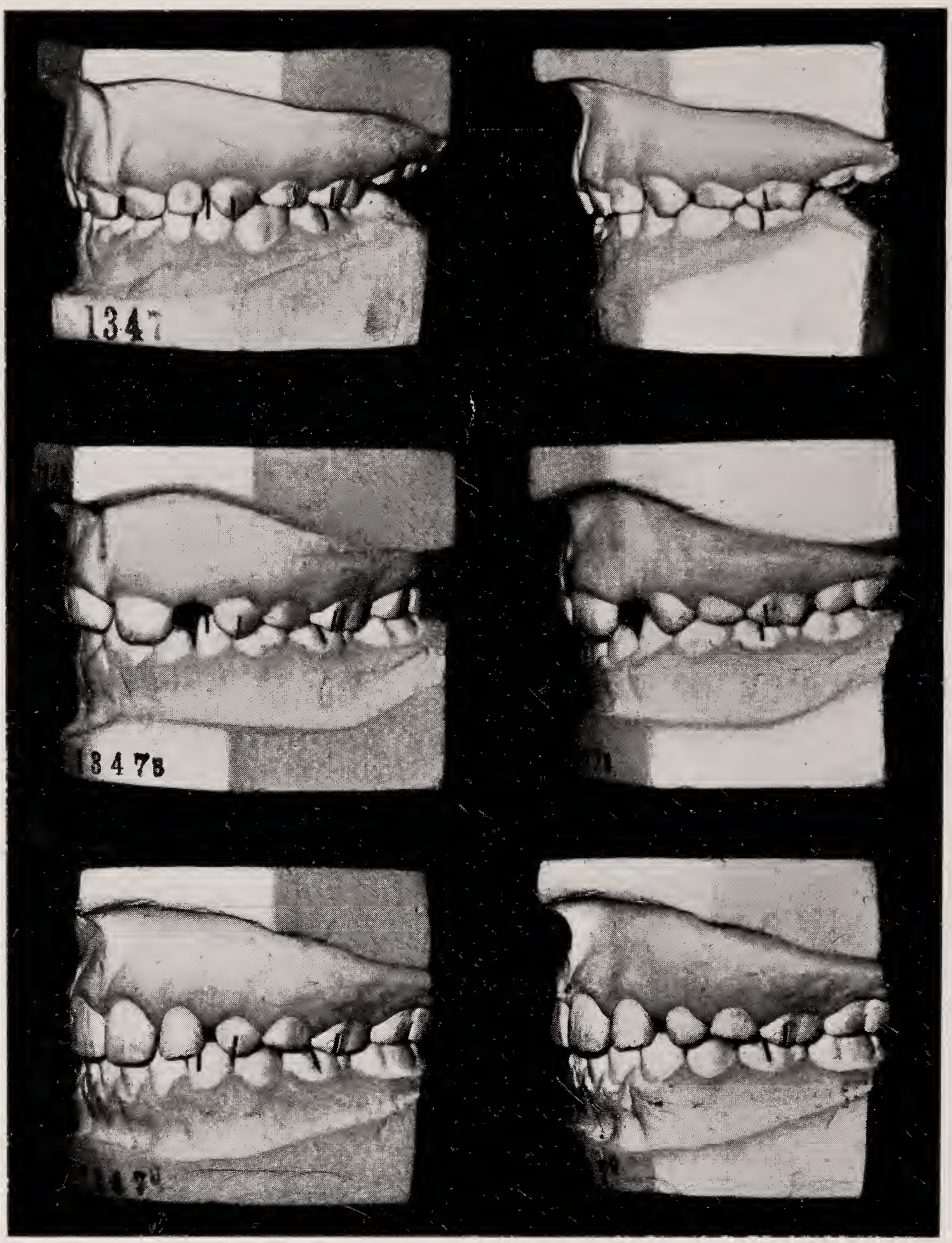
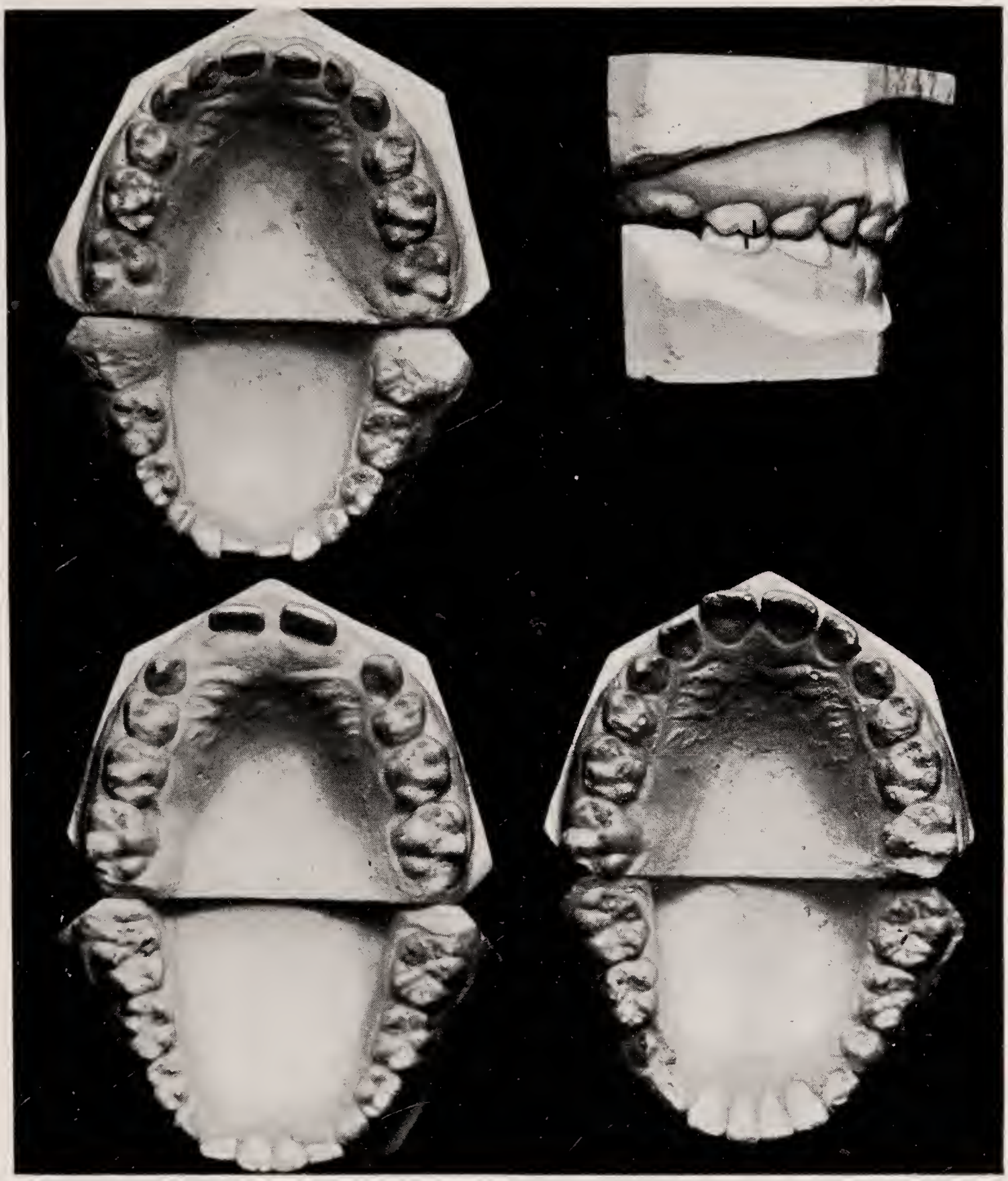


Fig. 1.

a

b



e

h

Fig. 1.

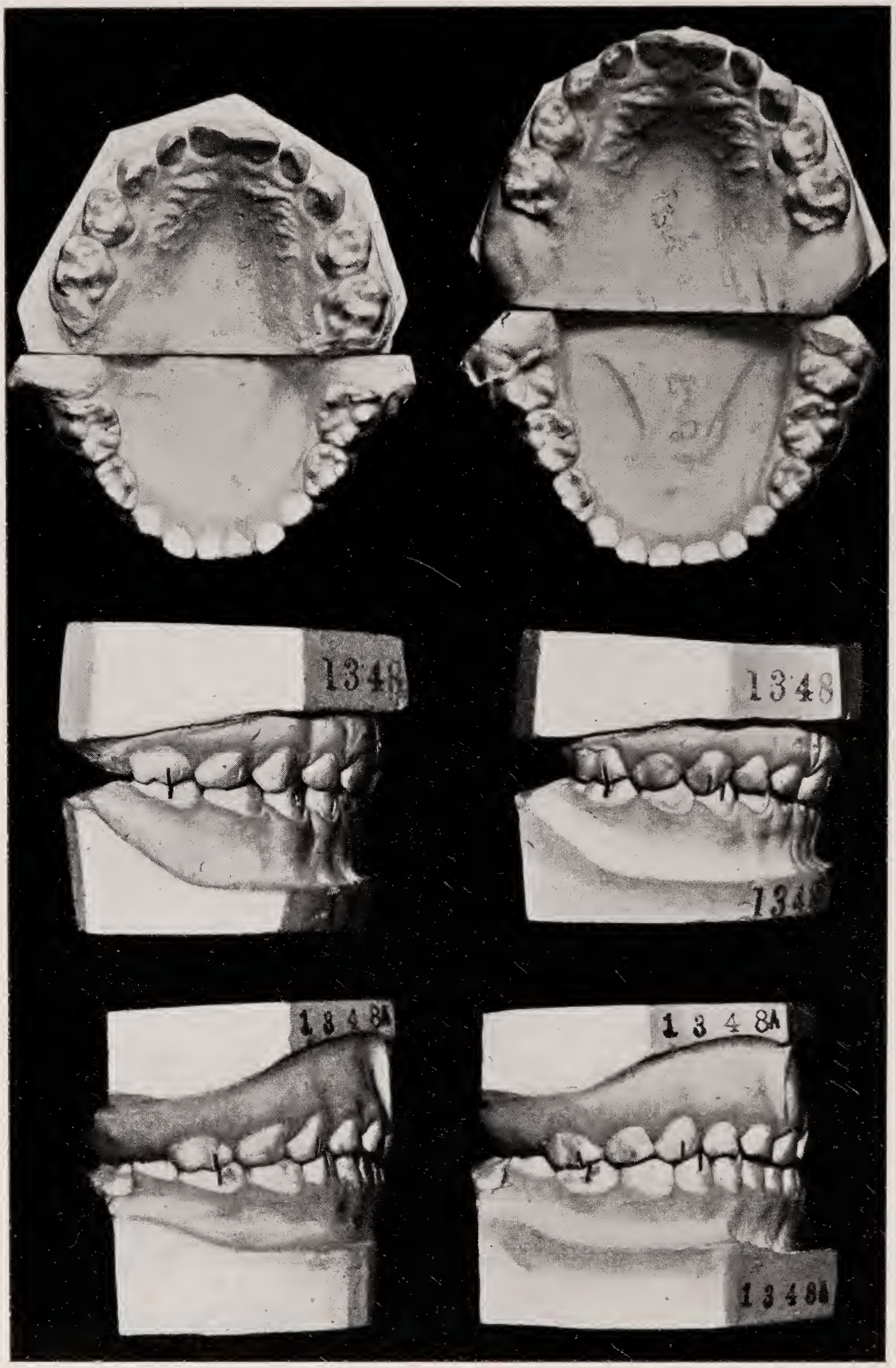


Fig. 2.

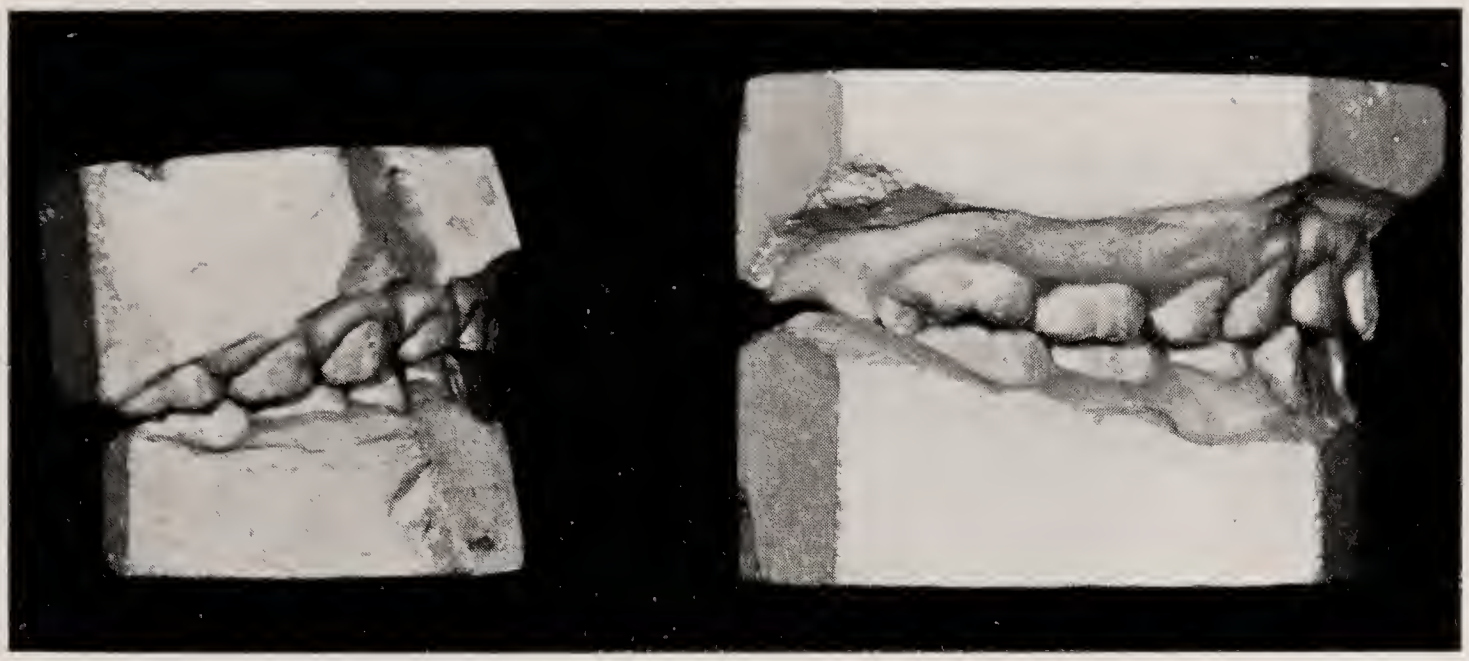


Fig. 3.

Fig. 4.

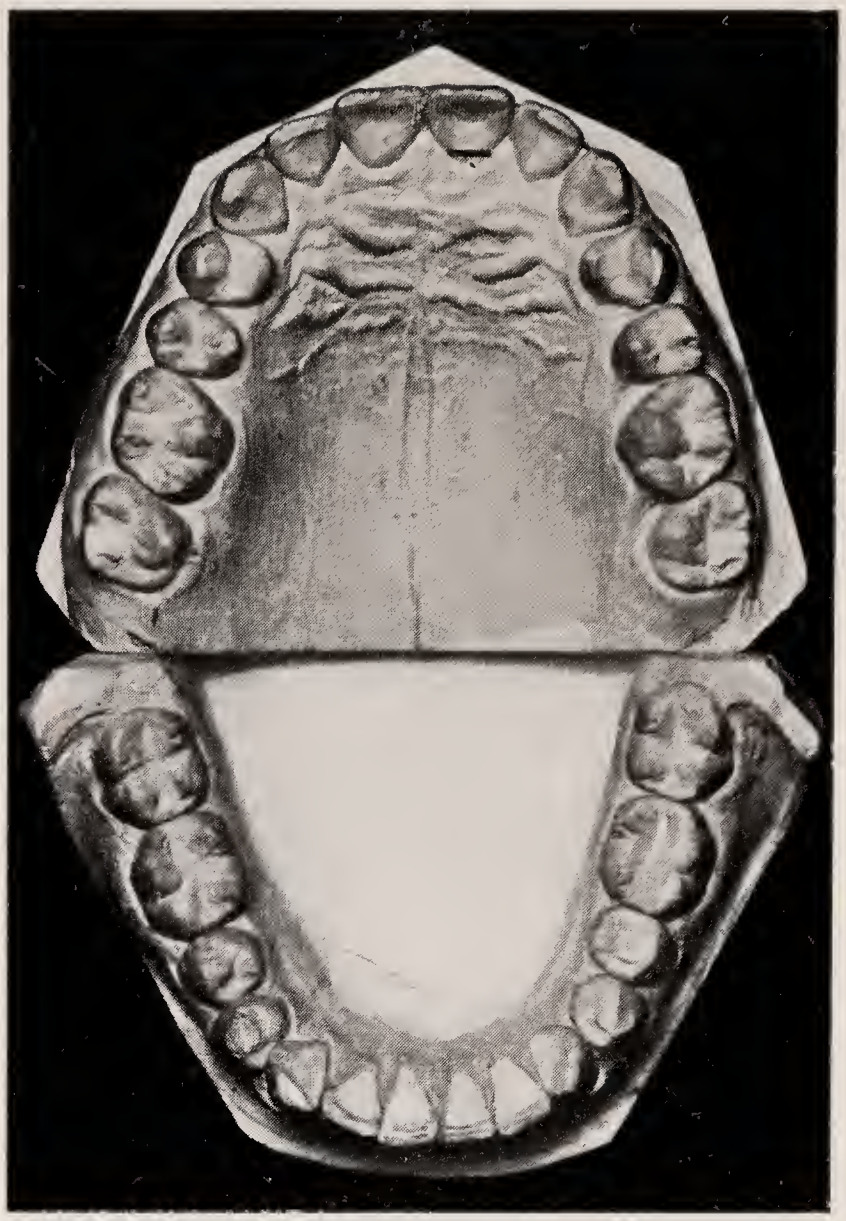


Fig. 5.

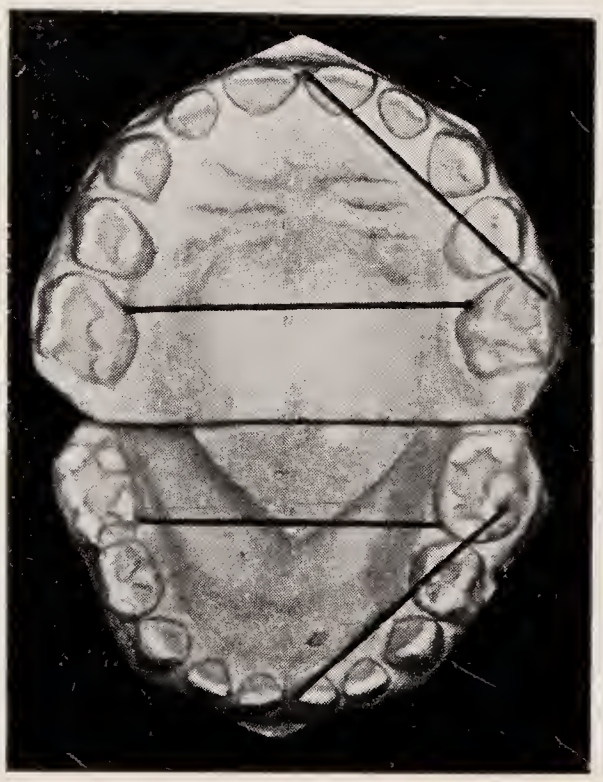


Fig. 6.

cusp points of C | C do not occlude between C B | and | B C at this period, but more distally ; overbite considerable.

(*f*) Age 6–9. Left side to show $\frac{|\,C}{|\,C}$ occlusion. | C more medial in relation to | C than in Fig. 1*c* ; overbite as in Fig. 1*c*.

(*k*) Age 9–5. Left side to show $\frac{|\,C}{|\,C}$ occlusion. | 3 cusp point between | 2 C. Considerable space between | 2 C (*cf.* Fig. 4, age 9–2, no space). | C overlaps | 3 4 less than | C D, so overbite may be less.

(*d*) Age 5–7. Left side to show $\frac{|\,E}{|\,E}$ occlusion. | E buccal groove fractionally medial to cusp point and triangular ridge of medio-buccal cusp | E (*cf.* Fig. 1*b*).

(*g*) Age 6–9. Left side to show $\frac{|\,E}{|\,E}$ occlusion. | E more medial in relation to | E than in Fig. 1*d*. More contact between | E and | D when in occlusion than at age 5–7. Normal relation of $\frac{|\,6}{|\,6}$ at this age.

(*m*) Age 9–5. Left side to show $\frac{|\,E}{|\,E}$ occlusion. | E markedly more medial in relation to | E than at age 6–9 ; | 6 is also more medial in relation to | 6. Overbite normal.

The marked change in the overbite to be seen in Fig. 2 between ages 3–10 and 6–0 is not observable in this case.

TABLE to show width of arch (in millimetres) at :—

Age.	*Buccal surface.* C | C	D | D[1]	E | E[2]	6 | 6[3]
5–7	34.20	34.00	39.10	43.00[4]
6–9	37.00	35.20	41.10	45.75[5]
9–5	38.20	37.20	42.60	47.00
Increase in 3–10 years	4.00	3.20	3.50	4.00
Corrected figure	—	—	—	2.50

[1] D | D measurement taken from the medial groove at the convergence of the medio-buccal and medio-lingual cusps.

[2] E | E measurement taken from the medial groove at the convergence of the medio-buccal and medio-lingual cusps.

[3] 6 | 6 measurement taken from the central fossæ at the base of the lingua cusps.

[4] $\frac{6|}{6|}$ and $\frac{|\,6}{|\,6}$ are not in occlusion.

[5] $\frac{6|}{6|}$ are not in occlusion ; 6 | has to go lingually or | 6 bucally, or both movements have to occur before $\frac{6|}{6|}$ will occlude correctly ; not more than 1.50 mm. lingual movement of 6 | will bring their relationships correct, hence the " corrected figure," which probably puts the breadth increase lower than it actually is.

Summary of points to be noticed in Fig. 1.

Spacing behind $\frac{C \mid C}{C \mid C}$ at age 5–7, which does not exist at age 6–9, probably closed by C | C going distally (and if distally also buccally): this might cause an increased C | C breadth of 1 mm. Space between | 2 and | C at age 9–5.

During 3–10 years C | C have widened 4 mm. and 6 | 6 2.50 mm.

No noticeable attrition; no change in overbite.

Difference in the medio-distal relation of $\overline{E \mid}$ and $\overline{\mid E}$ to the upper teeth at age 5–7, which persists until age 9–5, when $\frac{6\,C \mid C\,6}{\overline{6}\,3 \mid 3\,\overline{6}}$ appear to be in normal occlusion. Centre lines coincide in all three sets of models.

FIG. 2.—NORMAL OCCLUSION. (No treatment.)

(*a*) Age 3–10. Occlusal view. Spaces behind all the canines and between all the upper and lower teeth in front of these except between the centrals. Very slight incisor spacing (*cf.* Fig. 6). C | C widen 0.75 mm. in next 2–2 years.

(*c*) Age 3–10. Right side to show $\frac{E \mid}{\overline{E \mid}}$ occlusion. $\overline{E \mid}$ buccal groove coincides with cusp point of medio-buccal cusp point of E |.

(*d*) Age 6–0. Right side to show $\frac{E \mid}{\overline{E \mid}}$ occlusion. $\overline{E \mid}$ buccal groove slightly more in front of the cusp point of medio-buccal cusp point of E | than at the age 3–10. The overbite is less than at age 3–10.

(*b*) Age 6–0. Occlusal view. All canine spaces have disappeared except upper medial, but all other spaces as before except $\overline{1 \mid 1}$ are erupting and there are no spaces on either side of them. Some attrition of $\frac{C \mid C}{\overline{C \mid C}}$.

(*e*) Age 3–10. Right side to show $\frac{C \mid}{\overline{C \mid}}$ occlusion. $\overline{C \mid C}$ cusp points are distal to the spaces between C B | B C, especially the left one. Overbite considerable.

(*f*) Age 6–0. Right side to show $\frac{C|}{C|}$ occlusion. $\overline{C|}$ is considerably more forward than at the earlier period, the cusp point being between $\underline{CB|}$ now and its medial incline in contact with $\underline{B|}$. Reduction of overbite in 2–2 years.

TABLE to show increased breadth of arch (in millimetres) between age 3–10 and 6–0.

	$\underline{C \mid C}$	$\underline{D \mid D}$	$\underline{E \mid E}$	$\overline{C \mid C}$
Increase in 2–2 years ...	0.50	0.50	1.00	0.75*

Summary of points to be noticed in Fig. 2.

During two years (age 3–10 to age 6–0) spaces on both sides of $\frac{C|C}{C|C}$ have all disappeared at age 6–0 (except $\underline{C|C}$ medial).

Medial movement of all the lower teeth in relation to the upper ones.

Considerable opening of the bite. Some attrition.

Another case, previously described,[2 and 3] is shown in Fig. 3, ages 4–0 and 9–2; Fig. 4, age 9–2, and Fig. 5, age 20–1; in Fig. 3, notice the change of overbite; in Figs. 4 and 5 the width across $\underline{C|C}$ and $\underline{3|3}$, medio-lingual surfaces, is exactly the same; this surface of the canines, deciduous and permanent, may perhaps be considered as a fixed point (as far as this term is permissible). Between the ages of 9–2 and 20–1 there has been an increase in the width of the first upper permanent molars of 1.15 mm., and of the lower ones of 0.3 mm. Fig. 6 is the occlusal view of this case at 4 years of age.

The cases presented above are a study of individual examples of normal occlusion. Normal occlusion has also been studied *en masse* by the statistical method; the results are presented in "Facial Growth in Children," † [8] by Miss K. C. Smyth and Dr. Matthew Young, a publication of the Medical Research Council, Special Report Series, No. 171. This report has received little notice in comparison with the enormous amount of work required for its compilation. Some details of the report are now discussed.

It is significant that the general characters of developing normal occlusion, as seen in individual cases, are brought out by the statistical method; however, the practitioner should not neglect to collect and study series of models of cases as these show the changes as they occur and bring out details which probably cannot be observed in other ways.

The report deals solely with normal occlusion and facial growth in cases of normal occlusion; it is based on the results of the examination of 1,200 children who had a morphologically normal or ideal type of occlusion and were 6 per cent. of those examined, but an additional 2 per cent. (estimated) with the same type of

* If the bite opens it becomes possible for $\overline{C|C}$ to show greater breadth increase than $\underline{C|C}$.

† The page references in the text are to pages in "Facial Growth in Children."

occlusion were rejected; this makes a total of 8 per cent. with ideal occlusion (a much higher standard of occlusion than normal), and strikes a casual observer as being higher than would be expected. There are numerous facial measurements in addition to the dental measurements.

The measurements of other workers are confirmed as regards increase in breadth of the deciduous arches during the persistence of the deciduous molars.

New measurements, which are further evidence of growth, e.g. the increased breadth $\frac{6|6}{6|6}$, ages 8–14 years (Table 2, page 27‡), are included* :—

		Increase of breadth of arch.	
		Maxilla $\underline{6|6}$.	*Mandible* $\overline{6|6}$.
Ages 8–14	Boys	1.13†	0.84†
	Girls	2.38	1.57

Points of Measurement.

The procedure adopted for dental measurements calls for comment.

At the beginning of the investigation *internal* measurements of the breadth of the upper and lower dental arches at $\frac{D|}{D|}$ or $\frac{4|}{4|}$ and $\frac{6|}{6|}$ were taken, but later these measurements were abandoned and "maximum" external measurements at the same teeth were taken in their place; no reason for the change is given. If the internal measurements had been used throughout the increase in width, which the external measurements show to have occurred, would have been less, or even shown not to have occurred. (Table 1, page xiv of this paper.)

Buccal (maximum external breadth) and lingual measurements—made for purposes of comparison—could only be satisfactory if taken at the same point, obviously very difficult on surfaces possessing contours, such as the teeth concerned, a task not rendered easier by having to be made in the mouths of children (pages 10 and 16‡). To compare measurements made from deciduous teeth and those made from their permanent successors, as if they were the same object, does not carry conviction.

* The only other $\frac{6|6}{6|6}$ breadth measurements in the same individual, having normal occlusion, at different ages, which the writer has found in the literature, are by :—

Spiller (one case),[9] Sim Wallace (one case),[11] Zsigmondy (one case).[12]

† It is stated on page 45 of the report‡ that "The number of observations is relatively small . . . and probably inadequate"; see table under heading "Buccal Breadth of Dental Arches at $\underline{6|6}$ and $\overline{6|6}$" (page xv of this paper), in which the result of the measurements are more as would be expected.

‡ Facial Growth in Children.

Buccal Measurements.

Maximum external breadth of dental arch (B* at $\underline{D \mid D}$, at $\overline{6 \mid 6}$, etc.) is taken to mean that the measurements (in view of the ages at which they were taken) were made at the gingival margin ; it does not seem possible they could have been " taken at the neck of the tooth at the base of the disto-buccal cusp " (page 16‡).

Whether the arch breadth is measured at the base of the medio-buccal or disto-buccal cusp (gingival margin) of $\underline{D \mid D}$ there is an increase in breadth, as a result of denudation, apart from any other cause. Much more of the buccal surface of $\frac{6 \mid}{6 \mid}$ is exposed below the medio-buccal cusp than below the disto-buccal cusp at age 8 years.

In the upper arch this measurement will increase slightly with age, even though the tooth remains in exactly the same position, on account of the contour of the tooth and its gradual denudation as age increases ; the same is true in the lower arch, but to a greater degree.

The greatest bucco-lingual width of $\frac{D \mid}{D \mid}$ (i.e. of the teeth themselves), exposed in the normal healthy mouth, varies with age as a result of denudation. Figures of an actual case, measured on the models (Figs. 3, 4 and 5) are :—

Age.			*Width (Bucco-ling.).*					*Increase.*
4–0	...	$\underline{D \mid}$	8.375 mm.	...	...	...	...	—
9–2	...	$\underline{D \mid}$	9.250 mm.	...	...	...	...	0.875 mm.
				Age.				
20–0	...	$\underline{4 \mid}$	9.875 mm.	4 to 20 ($\underline{D \mid}$ and $\underline{4 \mid}$)				1.500 mm.
				9 to 20 ($\underline{D \mid}$ and $\underline{4 \mid}$)				0.625 mm.

Age.			*Width (Bucco-ling.).*					*Increase.*
4–0	...	$\overline{D \mid}$	6.750 mm.	...	...	...	...	—
9–2	...	$\overline{D \mid}$	7.875 mm.	...	...	...	...	1.125 mm.
				Age.				
20–0	...	$\overline{4 \mid}$	8.175 mm.	4 to 20 ($\underline{D \mid}$ and $\overline{4 \mid}$)				1.425 mm.
				9 to 20 ($\underline{D \mid}$ and $\overline{4 \mid}$)				0.300 mm.

The measurements are given to three decimal points because they are the averages of measurements made by two observers.

The amount of increase in width of $\underline{4 \mid}$ over $\underline{D \mid}$ depends on the age at which the measurement of $\underline{D \mid}$ is made, being more than twice as great at the longer interval in the above case.

Black[1] gives the following measurements of bucco-lingual diameter (" the greatest diameter of the crown in the direction named ") :—

* B = Breadth.
‡ Facial Growth in Children.

				Increase in width of
$\underline{D}$ 8.5 mm.	...	$\underline{4}$	9.1 mm. average 10.0 mm. maximum 8.0 mm. minimum	$\underline{4}$ (average) over $\underline{D}$ = 0.6 mm.
$\overline{D}$ 7.0 mm.	...	$\overline{4}$	7.7 mm. average 8.0 mm. maximum 7.0 mm. minimum	$\overline{4}$ (average) over $\overline{D}$ = 0.7 mm.

It is presumed that Black's measurements were made on extracted teeth.

The fact that none of the buccal surfaces are vertical or parallel increases the difficulties of making measurements.

Canine measurements have not been recorded; the work of other investigators shows greater breadth increases in this region than elsewhere. Lewis[6] says: "the deciduous arches become wider, to allow for the increased size of the permanent incisors, the greatest increase occurring after the age of 6 years; the greatest increase is in the upper canine region." The position at which canine measurements should be taken requires consideration.

Cusps are unsuitable points for measurement, because of the difficulty of measuring at the same point every time; in the case of deciduous teeth these are liable to attrition (Fig. 4), and if this occurs the point of measurement may have disappeared.

It is more difficult to measure molar and premolar breadth on models (and in the mouth it is to be presumed the difficulties are greater) at the lingual and buccal surfaces than in a sulcus, which would seem to be the situation at which these measurements should be made, because they do not change, and a resting point is provided for the measuring instrument.

Lingual Measurements.

If $\frac{D \mid D}{D \mid D}$, $\frac{4 \mid 4}{4 \mid 4}$ and $\frac{6 \mid 6}{6 \mid 6}$ remain in the same position during the years of investigation, but the normal denudation of the teeth, which occurs in the course of time, takes place and measurements are made at the gingival margin, these measurements will show a decrease on account of the contour of the teeth; these contours may be seen in Figs. 1 and 5. This is a factor which needs to be considered when breadth is measured from the lingual surfaces as well as when it is measured from the buccal surfaces.

Breadth of Dental Arches at $\underline{D \mid D}$ or $\underline{4 \mid 4}$.

The following table is adapted from the report (pages 27, 45 and 50‡):—

Increased breadth $\underline{D \mid D}$ *or* $\underline{4 \mid 4}$.

		Boys.	*Girls.*
Ages 2.5*–4.5	...	Upper: increase insignificant.	Lower: none.

* Age 2.5 means $2\frac{5}{10}$ years: the method of expressing age is changed so as to correspond to the method used in the report.

‡ Facial Growth in Children.

		Upper.	*Lower.*	*Upper.*	*Lower.*
Ages 4·5–8·5	...	2·8	1·6	2·66	2·15
Ages 8·0–14·0	...	2·3	2·2	2·74	2·22
Total	...	5·1	3·8	5·4	4·37

The buccal surfaces of D | D and 4 | 4 are regarded in the report* as interchangeable as points of measurement; no reason is given for this assumption; might it not be assumed with equal justification that the lingual surfaces are interchangeable; it seems that the latter is more probable than the former (Table 1). The measurements in Table 1 of a case (Figs. 4 and 5) show:—

(1) The different result obtained as regards increase of arch breadth when buccal and lingual measurements are used; and probably

(2) that the lingual surfaces of D | D and 4 | 4 occupy the same position; and

(3) that the change of teeth is not accompanied by bone growth. It seems probable that growth of bone occurs before eruption; in this case D | D breadth increases 2 mm. between 4 and 9 years, that is, before 4 | 4 erupt; the space for permanent incisors between deciduous canines is usually, but not invariably,† large enough when the teeth erupt. (Figs. 1, 6 and 4.)

A further subject for investigation would be to find out if any of this increased breadth (D | D or 4 | 4) is due to growth, and how much is due to change of teeth. Table 1 analyses the case shown in Figs. 3, 4, 5 and 6 with this object in view; the increased breadth of 4 | 4 over D | D, due to *growth*, appears to be not more than 3 mm. (and not 5 mm. as suggested in the report (pages 47 and 50‡), only 2 mm. increase can be shown to be so caused, leaving 1 mm. increase to be accounted for.

* Dr. Matthew Young writes: "I did not intend to convey the impression that the buccal surfaces of D | D and 4 | 4 are interchangeable as points of measurements."

† In one case[4] C | C widened 1 mm. between ages 6–8 and 8–4; at age 6–8 2 1 | 1 2 were imbricated, at 8–4 they were in good alignment. The four lower incisors had erupted before the first measurements were taken, so that there has been no change of lower teeth during the period observed. In Figs. 6 and 4 C | C breadth increase is 2.25 mm. in four years, age 4 to 9: there are no models to show if there was imbrication of 2 1 | 1 2 at any time. In this case 4 | is wider bucco-lingually than D | by 1.25 mm.

‡ Facial Growth in Children.

TABLE 1.

Measurements of Case, Figs. 4, 5 and 6 (Boy).

Arch breadth in millimetres.

Age.		*Lingual surface.*	*Buccal surface.*
4–0	... D | D	27.0	44.2
9–2	... D | D	28.5	46.2
21–0	... 4 | 4	28.5	49.2
Increase when 4 | 4 replace D | D	...	Nil.	3.0
| D = 9 mm. | 4 = 10 mm.: difference due to 4 | 4	... ...		2.0
Increased 4 | 4 width that may be due to growth ...			1.0
Increased D | D width 4–0 to 9–2 years			2.0
Increase due to growth			3.0
Increase due to 4 | 4			2.0
Total increase			5.0
Average increase as given in the report			5.1
Increase due to growth, not more than			3.0

Between 8 and 14 years there is an increase in this breadth (D | D or 4 | 4) of 2.3 mm. (boys), and 2.7 mm. (girls) (page 45‡), but the real significance of this increase cannot be assessed, because at the earlier age the first deciduous molar is the point of measurement, and at the later age the first premolar; the latter tooth has a greater bucco-lingual width than its predecessor (in many cases not less than 1 mm., which is 20 per cent. of the total increment in breadth in ten years, ages 3.5–13.5, and this has to be considered on both sides of the mouth, making a total of 40 per cent. due solely to the change of teeth); therefore, some of the increase must be due to the change of teeth, and not all of it due to growth, as a reader of the report might infer, because these gains are described as "statistically significant."

This problem may be viewed from another angle. Arches with $\frac{4 \mid 4}{4 \mid 4}$ in position are broader than those with $\frac{D \mid D}{D \mid D}$ in position (ages 9–10.5) by the amounts shown in millimetres in the following table:—

	Maxilla.	*Mandible.*
Boys	1.99	1.71
Girls	1.37	2.08

(Table 10, page 50.)

It will be noted that the increased breadth in the maxilla corresponds to the increased breadth of 4 | 4 over D | D, as shown in Table 1 above.

‡ Facial Growth in Children.

Are these increases due to :—

(1) A difference in bucco-lingual width of the teeth D | D and 4 | 4, which will include differences due to the contour and inclination of the tooth and its degree of denudation?

(2) A difference in position, in the bone, of 4 | 4 to that occupied by D | D?

(3) A growth of bone?

(4) A combination of these and other factors?

The report states that "the results of the present inquiry seem to indicate quite definitely that the dental arches increase in transverse diameter with age in the age interval 8–14 years" (page 50‡). The inference the reader would draw from the statistics is that the increased width is the result of bone growth *only*, but sufficient has been said above to show that the evidence on this point is not conclusive.

Buccal Breadth of Dental Arches at 6 | 6 and $\overline{6 \mid 6}$.

Between 8.5 and 12.5 years there is a mean increase, as shown in the following table (adapted from page 45‡) :—

		Age.	6 | 6	*Age.*	$\overline{6 \mid 6}$
Boys ...	...	8.5 to 12.5	1.8 mm.	8 to 13	1.3 mm.
Girls ...	...	do.	1.9 mm.	do.	1.3 mm.

For reasons stated above it is doubtful to what extent the increase, between 8 and 12 years, is due to bone growth, and to what extent to increased denudation of the teeth; and it is anomalous that the increase in breadth is greater of the upper than the lower molars, whereas one would have expected the reverse, as the lower molar buccal surfaces diverge at a much greater angle than the upper ones; this is another point that needs explanation—one is suggested below. Between 12 and 14 years there is a tendency for 6 | 6 and $\overline{6 \mid 6}$ breadths to increase (page 45), but this extra breadth probably results from exposure of more of the buccal surface and not from growth at all.

It has already been stated that in one case (girl) (Fig. 1) 6 | 6 breadth increased 2.50 mm. in 4 years (ages 5–7 to 9–5), and in another case (boy) (Fig. 3) 6 | 6 breadth increased 1.15 mm. in $10\frac{1}{12}$ years (ages 9–2 to 20–1). In another case (Fig. 419, "Bennett's Dental Surgery," Vol. I, 2nd ed.) 6 | 6 breadth increased 1.25 mm. between ages 6–8 and 8–5; 1.8 mm. between 6–8 and 10–7; and 3.5 mm. between 6–8 and 14–6. This brings out what may be more important as regards 6 | 6 breadth—that as great or a greater increase of 6 | 6 breadth takes place at an age earlier than is dealt with in the report as occurs during the period dealt with.

‡ Facial Growth in Children.

Lingual Breadth of Dental Arches at $\underline{6 \mid 6}$ and $\overline{6 \mid 6}$.

(Both sexes.) (Page 49‡.)

The following table is given to show that the internal breadth of the dental arch shows a smaller increase than the external or buccal breadth.

Age in years.		$\underline{6 \mid 6}$	$\overline{6 \mid 6}$
8–10	... ...	34·1	32·6
10–12	... ...	34·9	33·1
12–14	... ...	35·6	33·2
8–14	Increased breadth ...	1·5	0·6

Two further points may need to be considered when making and comparing breadth of the dental arch at $\frac{6 \mid 6}{6 \mid 6}$.

(1) The process of eruption includes the adjustment of opposing teeth in occlusion, the effect of the action of their inclined planes on one another; the lips, cheeks and the tongue may also play a part in effecting this adjustment; it would seem that measurements may not be accurate until the teeth are in occlusion; these considerations apply to $\frac{5 \mid 5}{5 \mid 5}$, $\frac{4 \mid 4}{4 \mid 4}$, and $\frac{3 \mid 3}{3 \mid 3}$, as well as to $\frac{6 \mid 6}{6 \mid 6}$: also to deciduous teeth if used for measurement during the period of eruption.

(2) The dental arch converges towards the front, $\frac{6 \mid 6}{6 \mid 6}$ move medially when $\frac{E \mid E}{E \mid E}$ are lost; does any narrowing of $\underline{6 \mid 6}$ and $\overline{6 \mid 6}$ breadth during the 8–12 years period occur on this account? It would also be some explanation of why $\overline{6 \mid 6}$ breadth increases less than $\underline{6 \mid 6}$ breadth, as the former move rather more medially than the latter.

$\overline{C \mid C}$ breadth increases less than $\underline{C \mid C}$ breadth (unless the bite opens), but is compensated for by forward movement of the mandible[2]; may not a continuance of this process account for the lesser increase of $\overline{6 \mid 6}$ breadth than occurs in the upper arch? This is a similar process to that just described, but in the former the teeth fill up spaces by moving through the bone; the latter is a movement of the mandible as a whole with the teeth, or all the teeth, as a whole, through the bone.

Factors Which May Affect Arch Breadth Measurements, Buccal and Lingual, at Ages 2–5 and 8–14.

General.

Contours and inclinations—vertical and horizontal—of buccal and lingual surfaces of $\frac{6\,D \mid D\,6}{6\,D \mid D\,6}$.

None of the surfaces are parallel, or plane surfaces, or at right angles to the line of the arch.

Variation in degree of denudation of these surfaces.

Difficulty of locating a definite spot on such surfaces.

Accessory cusps.

Whether the teeth are at right angles to the line of the arch, or inclined to it, may be a factor.

Deciduous Teeth.

Attrition.

Change of angle of the tooth to the dental arch, i.e. bucco-lingual inclination.

Rotation, medio-distal, of the tooth in the dental arch.

Loosening.

Permanent Teeth.

$\frac{6 \mid 6}{6 \mid 6}$ should be in occlusion as close as their medio-distal positions permit before being used for measurements.

$\frac{6 \mid 6}{6 \mid 6}$ move medially when $\frac{E \mid E}{E \mid E}$ are lost.

The entire mandible is probably moving forward, carrying all the teeth with it; also there may be medial movement of all the teeth through the bone; the change of $\overline{E\,D\,C \mid C\,D\,E}$ occlusion (Figs. 1, 2 and 3) show that a movement of this character is occurring.

Deciduous and Permanent Teeth.

The more $\underline{4 \mid}$ bucco-lingual width exceeds that of $\underline{D \mid}$ the greater will the arch breadth be if the buccal surfaces are used for measurement.

The bucco-lingual width of teeth varies both antero-posteriorly and vertically.

Measurements of the character used for the report must be difficult to make in children's mouths; measurements from a sulcus or fossa would be less difficult.

Conclusion.

There appear on page 45 of the report‡ the words: "On account of the lack of agreement as to the points of contact for measurement adopted by different observers. . . ."

This suggests that agreement among workers as to the most suitable points of measurement is a necessity; a sulcus or fossa is suggested as best for cheek teeth, and the buccal surface for canines, with precautions against error, e.g. two observers and or more than one point of measurement.

Growth of arch breadth cannot be determined except by the use of the same teeth, not by successive teeth. Earlier measurements of $\frac{6 \mid 6}{6 \mid 6}$ breadth are necessary, to show if increased breadth is occurring there when it is taking place in $\frac{D \mid D}{D \mid D}$ region. $\frac{C \mid C}{C \mid C}$ breadth is also desirable; this would provide evidence over the entire period when $\frac{6\,E\,D \mid D\,E\,6}{6\,E\,D \mid D\,E\,6}$ are present and no local causes are affecting the position of $\frac{6 \mid 6}{6 \mid 6}$, except medial movement of the mandible as a whole.

‡ Facial Growth in Children.

An investigation of abnormal occlusion is now taking place, and it is hoped that the points brought out may be taken into consideration.

It has been pointed out that if the teeth $\frac{6\,E\,D\,C\,|\,C\,D\,E\,6}{6\,E\,D\,C\,|\,C\,D\,E\,6}$ remained in the same position, but normal denudation took place over the age period of the report, arch breadth in the case of :—

Lingual measurements would show decrease in arch breadth.

Buccal measurements would show increase in arch breadth.

Therefore such measurements should only be used if they can be made at the corresponding point every time.

It is hoped that the matters discussed above will enable research workers to eliminate possible sources of misinterpretation and error. The report shows in a remarkable way how the statistical method yields the same result as an individual case in the normal occlusion series ; it is doubtful if the literature of dentistry provides anything at all comparable.

Notes on Dental Arch Breadth and Length.

Figs. 3, 4, 5 and 6 illustrate a further point : that at age 9–2 the upper deciduous canine breadth—medio-lingual aspect—is exactly the same as the permanent canine breadth, but an increase in breadth of 3.50 mm. has taken place during the previous 5 years* ; this has given more than sufficient space for the incisors which are slightly separated ; but further growth is required for the accommodation of the distal aspect of 3 | 3 which is provided by the increased width of 6 | 6 and 4 | 4 after their eruption, otherwise further growth for the accommodation of the premolars and canines is not required : this accommodation is provided by the unimpaired deciduous molars and canines (probably plus some incisor spacing, e.g. in Fig. 1*m* | 2 C are spaced, in Fig. 3 1 | 1 and C 2 | are spaced).

It is a point frequently overlooked that if the deciduous molars are present unimpaired, the space for the premolars is always present, whether the arches are too small or not, i.e. deficiency of length of arch is not apparent in this area of the arch except for a local reason.

Increased breadth of arch after age 4 is necessary for the accommodation of the incisors ; it is uncertain if increased length by growth is necessary for this purpose ; in any case, it must be very slight ; the extra length of the arch is largely provided by the change of shape, inclination and length of the four permanent incisors compared with the deciduous ones.[5] If there is such a

* In Figs. 6 and 4 the deciduous canine measurements of arch breadth were found difficult to make with accuracy : the upper ones were taken by two observers at three different points, but the increased C | C breadth (denudation had taken place) did not agree in any instance ; it has been averaged at 3.50 mm., which agrees almost exactly with the measurements made in 1914.[2] The lower ones were also difficult ; the teeth appear to have changed their inclination and show signs of marked attrition. The increased C | C breadth is now given as 2.25 mm. (In 1914 it was recorded as 4 mm., which would appear to be incorrect.) Loosening of deciduous teeth may need to be considered when making measurements.

thing as forward growth in the upper incisor region, its deficiency will have the same effect on the incisor teeth as deficiency of breadth—crowding in the incisor region. Tomes[10] suggests that the closure of the premaxillary suture of man at birth and little or no forward growth in the upper incisors region are correlated facts; in the apes this suture closes much later, or not at all, and these animals have marked increased length in the upper incisor region, apparently due to growth in length of the intermaxillary bone.

Provision of Accommodation for the Permanent Canine.

Black's[1] measurements give the increase in size of the upper permanent canine over the upper deciduous canine as 0.6 mm., so that the amount of extra space to be provided for 3 | is small (in the case shown in Fig. 3 the difference is 0.75 to 1 mm.); it may be provided by some of the excess deciduous molar space and by the further increase of arch breadth after 2 1 | 1 2 are in position (already referred to), as well as by any excess space in the incisor region due to previous growth across C | C: probably less than .5 mm. on each side of the deciduous canine is required to give the additional accommodation required, which partakes partly of length and breadth owing to the position of 3 | 3 in the arch.

The shape of the canine—a double wedge with one apex directed lingually and the other directed occlusally—facilitates this tooth coming into position and occupying a space which at times may appear too small for it.

It would appear that the medial surfaces of the deciduous canines at 9 years of age are a fixed point in the arch, as far as any part of the arch can be so described; if the permanent canine closes incisor spaces then its medial surface is more forward (and perhaps infinitesimally, but not necessarily more lingual than that of its deciduous predecessor). These considerations suggest that actually the centre of C | and of 3 | occupy the same position, but this point is not so readily accessible as the medio-lingual corner. If the medial surface of 3 | is more forward than that of C | then it would seem that 2 1 | 1 2 must also be more forward than B A | A B at 6 years of age, in order that the curve assumed by the six anterior teeth is similar; from this it would be inferred that there is forward growth in the upper incisor region.

Calculation of the Normal Deciduous Arch.

It is suggested that the normal length and breadth of the upper deciduous arch may be calculated from the width of the upper deciduous central incisor plus spaces* in the case shown (Figs. 3, 4, 5 and 6) at age 4 years, four times the resultant gives the breadth and the length of the arch as defined (Fig. 6).

* The width of the spaces between the different teeth varies in different cases, sometimes greater between A | A than elsewhere (Fig. 1); sometimes greater between B A | than between A | A, or these may be equal (Fig. 6).

Upper Arch.

$$\left.\begin{array}{l} \underline{|\,A} \text{ width} + \tfrac{1}{2}\underline{B\,A\,|} \text{ space} + \\ \tfrac{1}{2}\,\underline{A\,|\,A} \text{ space} \times 4 \end{array}\right\} = \text{Length only and breadth only.}$$

FIG. 6.—$\underline{A\,|}$ width = 7 mm.; Half $\underline{B\,A\,|}$ space = 0.5 mm.; $\frac{1}{2}\,\underline{A\,|\,A}$ space = 0.25 mm.

Definition of:

Length. $\underline{A\,|}$ medio-inciso-buccal corner to $\underline{E\,|}$ medio-buccal cusp.

Breadth. $\underline{E\,|\,E}$ gingival margin just in front of medio-lingual cusps where there is a minute sulcus.

These two measurements, length and breadth, are the same (Fig. 6).

Fig. 6 is the same case shown in Figs. 3, 4 and 5 and may be regarded as typically normal; Dr. Matthew Young says he "would expect some variation in a ratio about 4 (though perhaps not such a wide variation as in the ratio for the lower arch (5.14)," as given below), to be applicable to the calculation of the normal deciduous arch. In other words the ratio for the upper arch in normal cases will vary between figures which are rather less than, and greater than, four.

Lower Arch.

$$\left.\begin{array}{l} \overline{A\,|} \text{ width} + \tfrac{1}{2}\overline{B\,A\,|} \text{ space} + \\ \tfrac{1}{2}\,\overline{A\,|\,A} \text{ space} \times 5.14 \end{array}\right\} = \text{Length only and breadth only.}$$

FIG. 6.—$\overline{A\,|}$ width = 4.5 mm.; $\tfrac{1}{2}\overline{B\,A\,|}$ space = 0.5 mm.; $\frac{1}{2}\,\overline{A\,|\,A}$ space = 0.25 mm.

Definition of:

Length. $A\,|$ medio-inciso-buccal corner to $E\,|$ medio-buccal sulcus occlusal edge.

Breadth. $\overline{E\,|\,E}$ gingival margin just in front of medio-lingual cusps, where there is a minute sulcus.

These two measurements, length and breadth, are the same.

Three cases have been tested (Figs. 1, 2 and 6): in the case of the upper arch the ratio was found to be exact; in the case of the lower arch there was no uniformity in the results; notes are appended to these lower measurements which may, to some extent at least, account for the discrepancies.

The actual measurements from which the ratios are obtained are:—

Upper.

Fig.	*Ratio.*	$\underline{A\,|}$ *Width and Spaces.*	=	*Length or Breadth.*	
1	4 ×	7.20	=	28.75	28.75
2	4 ×	7.50	=	30.10	30.10
6	4 ×	7.75	=	31.00	31.00

Lower.

Fig.	*Ratio.*	$\overline{A\,|}$ *Width and Spaces.*	=	*Length or Breadth.*	
1	4.6 ×	5.70*a*	=	26.00	26.50
2	6.8 ×	4.00*b*	=	27.20	27.20
6	5.1 ×	5.25	=	27.00	27.00

a $\overline{1\,|\,1}$ are erupting.

b Age 3–10: lower incisor spacing almost non-existent.

It is sufficient if the ratio is correct for the upper arch, as the condition of the lower arch may be diagnosed from that of the upper one.

In the case of abnormal arches without spacing, or too little spacing, it will be necessary to estimate what the spacing should be if it is desired to estimate the size of the arch.

It is important to include the incisor spacing with the width of A |. Northcroft[7] has stated that "the permanent teeth which succeed temporary teeth of from 6.1 to 6.5 mm. in width are wider than their predecessors by 38.7 per cent., whereas the permanent teeth which succeed temporary teeth of from 7.2 to 7.5 mm. in width are only 31.1 per cent. wider than the temporary teeth." It is probable that large deciduous incisors have less spacing than small ones. These considerations would tend to keep the ratio correct.

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[11] Wallace, J. Sim, "Variations in the Form of the Jaws," Baillière, Tindall & Cox, London, 1927.

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Discussion.

Mr. G. Northcroft said that so old a member of the Society as Mr. Chapman must have forgotten more than he, the speaker, had ever known, but he thought it well to point out that Sim Wallace had drawn attention to the increase in width between the first permanent maxillary molars after eruption, and that Sir Frank Colyer, later on, illustrated measurements on millimetre paper of his own children's mouths, which showed the increasing width of the palatal

distance between the first permanent maxillary molars. He did not know if it had been noticed that the deciduous incisors in three of the cases shown, were in retroclination, but after the permanent incisors had erupted the direction of the incisors seemed to be vertical —not in retroclination nor proclination. Therefore it did not necessarily follow that because the deciduous incisors were in retroclination that a Class II, Division 2 case would develop later on. Mr. Chapman had mentioned another interesting point when taking measurements. To have any value, the measurement should be a lingual one—it was the inside measurement of the arch that counted. Some premolars were broader than the deciduous molars, and some deciduous molars were broader than the premolars—the buccal and lingual diameters differed on account of the size of the teeth and not on the size of the arch. Mr. Chapman referred to some work which the speaker did for the Dental Board a long time ago. It concerned the ratio between the size of the deciduous incisor and the size of the permanent incisor. On the average it was found that if there was a big deciduous incisor there would be a correspondingly large permanent incisor, and the small permanent incisor was preceded by a proportionately smaller deciduous incisor.

Miss K. Corisande Smyth said she had had only a few hours' notice of the communication by Mr. Chapman or she would have been able to produce measurements in connection with the question of external and internal arch measurements to which he had alluded. The change to which he had referred was made early in the investigations concerned, and the whole thing at that stage was rather dark to her. She was simply told that the change from the internal to the external measurement was to be made. But at the time she took a series of measurements both of the internal and external arch breadths of the same cases. Dr. Young had that series available, and if she had had time she would have produced them that evening. She thought that thirty or forty cases were measured, both internally and externally. Some question was raised as to the lingual inclination of the molars, particularly of the lower molars, being the factor which influenced the change. It might have been thought that the slightest increase of lingual inclination decreased the internal arch breadth.

Mr. O. N. Catchpole said that if a tooth was succeeded by a broader tooth, surely half that breadth was on the inner side of the centre, so that there would be a gain of only $\frac{1}{2}$mm. with each tooth, and the whole gain would be 1 mm., and not 2 mm. as Mr. Chapman had suggested.

Mr. H. G. Watkin suggested that the growth was brought about by the increasing size of the tongue. As Miss Smyth had mentioned, the molars gradually became straight again as a result of increasing internal pressure.

Mr. Harold Chapman, in reply, said that he was glad to hear Mr. Northcroft tell them that the premolars could be either narrower or broader bucco-lingually than their deciduous predecessors. It only went to show that when examining a few cases one was likely to fall into error, because he himself did not think he had measured one in which the premolar was smaller, and he believed this condition must be much less common than the other. With regard to retroclination, he thought that all lower incisors must tend to show retroclination with such overbite.

Mr. Northcroft said that he meant the maxillary.

Mr. Chapman said that Friel had shown that normally one would have what might be regarded as a tendency to retroclination in the deciduous incisors on account of their shape, which is very different to that of the permanent ones ; this is one reason why the larger permanent

incisors are able to be accommodated in an arch only a little larger than the deciduous arch. It was true, of course, that previous workers had brought forward the result of investigations on this subject. Mr. Campion had also made premolar and molar breadth measurements, but he did not remember that this principle had been brought home to him in such a concrete form as in the report which he had reviewed in his communication. What struck him more particularly was that the measurements of the molar increase which were given there as taking place after eight or nine years of age were insignificant as compared with the increase which he believed took place before that age, and if that were so it was an important point which should not be overlooked. He would have thought that a cusp was a better point for measurement than either the buccal or the lingual surface on which it was almost impossible to find a fixed point. He had referred to the inclination of the teeth in his written communication, but he had not read it. Mr. Catchpole had made a good point. His own argument was that if the lingual measurements had been taken they would have given smaller measurements and not shown any increase (they might show a decrease); so whichever way it was taken it did not negative the facts he had put before the meeting. Mr. Catchpole might be right. If the premolar came down exactly where the deciduous molar had been then one got, say, .5 mm. increase buccally, and .5 mm. decrease in breadth lingually on both sides. With regard to Mr. Northcroft's point, he was not sure whether he understood him correctly, but his recollection of Mr. Northcroft's lecture on "The Growth of the Jaws, etc." was that he stated that the permanent centrals were always larger than the deciduous centrals, but that the increase in width, when one had a large deciduous central, was relatively not as great as the increase when the deciduous central was small.

A CASE OF LINGUAL OCCLUSION OF THE UPPER INCISORS.*

By O. N. Catchpole, L.D.S.

This is a case which I treated in a simple manner. The patient, a girl, was 10 years, 11 months old when she first came to me. The lower incisors were in front of the upper incisors : the overbite was excessive. None of the second premolars had erupted, and after X-ray examination only the lower left second premolar was found present. I wanted to use a fixed apparatus and retract the lower jaw as a whole, leaving the upper incisors alone, but the mother was anxious that I should endeavour to do it with as little apparatus as possible, so I decided to attempt to treat the case by pushing forward the upper incisors only and leaving the lowers entirely alone.

The apparatus used was a removable plate, saddle-shaped, with Visick clasps for retention ; though the plate was free of the incisors there was a lingual wire at the necks of these teeth. To this wire I soldered an auxiliary spring, engaging the four incisors. In two months the upper and lower incisors were in correct relations and I removed the auxiliary spring.

I adapted the plate to act as a retainer by cutting the wire behind the incisors, bent it to the new position of the teeth and filled in the interval between the ends. This was worn for a further two months and was then discontinued. No other plate but the one described was used. The whole case only necessitated four visits after the fitting of the plate. The auxiliary spring was adjusted twice : at the third visit this spring was removed and the plate converted into a retention plate. At the fourth visit the apparatus was discarded.

The case interested me, as the upper teeth moved over the lower incisors so easily : the bite was not opened at any period. I was a little afraid that the upper incisors might look protrusive when they were in front of the lower ones if nothing was done to retract the latter, but this is not particularly noticeable.

* *Transactions* of British Society for the Study of Orthodontics, 1934.

Discussion.

The President said that he had been very much interested in Mr. Catchpole's practical appliances. These cases always interested him, because he had argued that there was a pre-normal occlusion and also a pseudo pre-normal occlusion. He had had a similar case to the one shown by Mr. Catchpole, in which the normal arch relationship would have been with the incisors edge to edge, but as a " bite of convenience " the child got into the way of thrusting forward the mandible and getting a good chewing surface in that manner. That type of case was treated astonishingly well by just a slight forward movement of the incisors.

Mr. Visick congratulated Mr. Catchpole on the ingenuity of his appliance and on the success he had achieved in the case. It looked like being a permanent success too, and he thought it just showed how one could be pleasantly surprised sometimes in this orthodontic work, because the results were much better than one had reason to expect. He thought the success of the appliance was due to the most ingenious spring, and he could only hope he would remember it when he got a similar case.

RESPONSE TO ORTHODONTIC TREATMENT.*

By Robert Cutler, M.R.C.S., L.R.C.P., L.D.S.Eng.

At the February meeting many will remember Mr. Cale-Matthews drawing attention to the difficulties of estimating the response to treatment prior to the commencement of a case, and the one we are for the moment considering proves an apt illustration.

It is virtually a Class I irregularity, with marked narrowing in the maxillary inter-canine region and consequent gross misalignment of the upper incisors: a further small complication is the lack of eruption of the right second mandibular incisor, the temporary counterpart being retained.

It will be noted further that the crowding in the upper premaxillary region is reflected in the lower, the left mandibular second incisor being inlocked in its attempt at eruption.

Treatment was commenced on April 19th, 1933, a simple upper expansion appliance, with sharp anterior biting incline being employed, a simple lingual arch of Mershon type being fitted in the lower. For the first four months the upper appliance was worn all the time, i.e. day and night, and at meals; expansion and automatic alignment of the incisors proceeding steadily, whilst the anterior incline acted efficiently on the instanding lower incisor.

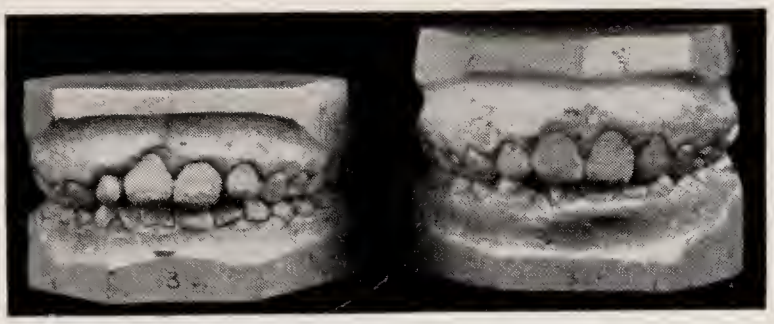
After four months a new upper appliance, identical in type to the former one, was inserted and was worn during the day and at meals only, whilst the retained lower right deciduous incisor was extracted, the gum over the unerupted permanent tooth being boldly cut away under a local anæsthetic.

At present the upper incisors are in very fair position, but expansion at a fair rate is continuing in both jaws, to allow room for the right mandibular incisor to assume a good position, as it will be noticed that it is now appearing through the gum.

Between April 19th, 1933, and the present time, eleven visits only have been paid, but already I must say that I feel relieved of much of my responsibilities in respect of her welfare.

* *Transactions* of British Society for the Study of Orthodontics, 1934.

1. Commencement of Treatment, April 1933.



2. Continuation of Treatment Test, 1934.

3. Treatment April 1933—March 1934.

This case, I think, illustrates the tremendous value and utility of the Badcock expansion alignment appliance, if carefully and correctly used, despite the arguments of those who claim that it is incapable of stimulating bone growth; and furthermore, how the use of such an appliance can be most charmingly combined with a lingual fixed mechanism in the lower jaw.

Advocates of extraction too, could hardly hope for a speedier resolution of the symptoms of irregularity, which first drew the attention of the parents to the need for treatment.

TREATMENT OF CANINE IRREGULARITY.*

By Robert Cutler, M.R.C.S., L.R.C.P., L.D.S.Eng.

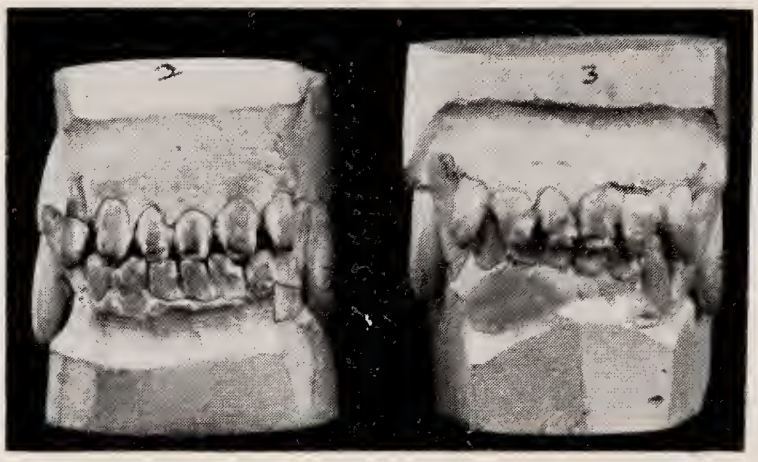
In initiating discussion on some of the simpler procedures in orthodontics, junior members of the Society—like myself—may well feel diffident, as nowadays there can be few mechanical problems that have not been encountered and satisfactorily surmounted by his seniors.

* *Transactions* of British Society for the Study of Orthodontics, 1934.

TREATMENT OF CANINE IRREGULARITY.

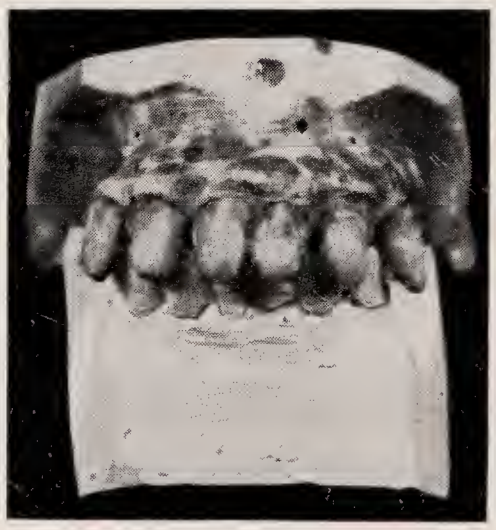
Instanding upper incisors in young bitch Cocker. Commencement of treatment.

Second view. Commencement of treatment.



Intermediate stage and completion of case.

Ideal occlusion in mature Cocker Spaniel, showing edge-to-edge bite.



Young Schnoutzer. Showing close bite and protrusion of upper incisors.

"Schnoutzer" Second view.

The case under review, which deals with moving teeth over the bite, is just such a one, but the circumstances are just a little unusual, as the patient is not human but canine, but I can assure you none the worse for that.

The first slide shows the original condition in which the two middle pairs of upper incisors are biting inside the lower ones, the third and outer pair being barely edge to edge ; the second shows an intermediate stage in treatment, and the finished case in which all three pairs of incisors are in good position.

About March of last year I was consulted by an eminent veterinary surgeon in respect of a valuable cocker spaniel belonging to a client of his : it was a bitch about eighteen months old, with many prize winning attributes, the main defect being the abnormal occlusion of the incisor teeth.

The owner was most anxious for attention to this defect, and several local dentists were consulted, but none could see their way to advise active treatment ; at that time I was not very knowledgeable on doggy matters and made my first visit in some trepidation, but this proved quite unwarranted, as I understand that show dogs are taught from birth to be well behaved under examination.

The general supposition was, that the case was one of inferior protrusion, i.e. Class III (of Angle), and it was felt that attention should be given to retraction of the lower teeth, but I diagnosed it as what I term Division 3 of Class I ; namely, a normal lower jaw associated with an upper shortened antero-posteriorly, and so I decided that the correct treatment was to advance the upper incisors.

I took impressions in trays cut from tinplate and fashioned on the spot, and moulds of the canines in copper rings, such as one would use for inlays, and at the next visit I tried in my platinised gold bands made on metal dies, and took further impressions in cast-metal trays.

I then made a simple appliance with fixed lingual arch and a suitably controlled finger spring, and cemented it in position with Ames No. 6 cement, the taste of which my patient found greatly to her liking. The case proceeded quite normally, but eventually I found that the advancing upper central incisors were pushing forward the corresponding lower ones (which I attributed to the relatively small size of the latter), so I fitted a simple labial wire fixed to bands on the lower canines, and under the influence of both appliances, the case advanced to a happy conclusion in August of last year. The case was naturally self-stabilising, and so needed no retention, and within a fortnight of cessation of treatment she was shown at her first exhibition, and gained a first and second award.

Working on this case naturally drew my attention to other irregularities of the canine dentition, and I was interested to hear that canine judges regard a virtual edge to edge incisor occlusion as being ideal.

Conversely, an excessive degree of overlap is considered unfavourably, this feature being found in a young schnoutzer (German sheep dog), where the close bite was associated with protrusion of

the upper incisors. (Slides illustrating both conditions were then projected on the screen.)

Treatment of the latter case has, so far, not been so successful as the previous one, but in both instances I felt well repaid for my efforts, not only for the joy that any orthodontist experiences in influencing the growth of a living thing, but for the realisation that principles and methods, if essentially sound, can be applied with success to vastly differing sets of conditions.

Discussion.

The President said that most of them had been invited by dog-lovers to undertake some work for their dogs, but few had had the courage to attempt it. It always seemed to him rather arbitrary on the part of dog-lovers to say what should be the correct position of the dog's teeth. In his early youth he had an acquaintance with bulldogs, and he remembered that the prenormal occlusion was looked upon as the correct thing for show purposes.

Mr. Harold Chapman asked whether Mr. Cutler used an anæsthetic on the dog or not. The point which had interested him most was the belief of the veterinary surgeon that one could, as regards treatment, divide by five in order to get the length of time required in the dog as compared with the human being. He recalled that Marshall, in the University of California, used the monkey and there employed the same argument, that because the monkey's life was ten years. the time could be divided by some figure to get the proper comparison with the human. His colleague, Mr. E. C. Sprawson, did not think that argument held good, and he had also spoken to Prof. Harris, the professor of anatomy at University College, who pooh-poohed the idea.

Mr. Maxwell Stephens asked what was the relative position of the maxillary teeth, and whether Mr. Cutler could add anything from the point of view of evolution generally.

Mr. H. G. Watkin asked whether the specimen which was handed round was a retention appliance, or whether it had some active function.

Mr. W. L. Boness said that he had been very much interested in this communication, and without desiring to deprive Mr. Cutler of the opportunity of replying to all the questions which had been addressed to him, he wished to say that he had the privilege of being present on one occasion when the treatment was being given. In reply to Mr. Chapman, who had asked what anæsthetic was employed, so far as he could see the only anæsthetic was the hypnotic effect of Mr. Cutler on the dog itself, for he treated the dog with extreme familiarity, and he and the animal seemed to be on the best of terms. As a great privilege to himself, Mr. Cutler allowed him to assist saying, "You hold the dog's mouth open while I paint the teeth with alcohol"—a thing which he (the speaker) did with some trepidation. Nevertheless, in his presence the dog's teeth were painted with alcohol, and the dog wagged its tail and appeared to be very pleased with the whole proceeding. No anæsthetic was applied, and the appliance was duly cemented in position. The whole performance was quite interesting, and the behaviour of the dog, particularly after the appliance was put on, was quite exemplary. The dog seemed just as proud to have its appliance on as children were proud to "show off" a dental mechanism to playmates who had not one.

Mr. Gray said that when he was in Philadelphia at the Graduate School of Orthodontics experiments were carried out on living monkeys. Lingual appliances with molar bands were fitted to their teeth and an

anæsthetic was used. It never occurred to them to try to cement the bands to the teeth without one. It was very interesting to note that the monkeys on recovering from the anæsthetic did not show any knowledge of the new appliance. They did not appear to mind it in the very least.

Mr. Robert Cutler, in reply, said that it was extraordinary to find how well these dogs bred for exhibition purposes behaved, even the most fearsome looking specimens. The dog in question was very good, and would sit on the table and look toward the light quite obediently, and did not seem to mind having the appliance on at all. As to the question of dividing time by five, that, he thought, had reference to the rapidity with which the teeth in the dog erupted. For instance, when he saw the temporary canines being shed in another dog, he was told that the permanent ones would be fully in position *in three weeks*, and this proved to be correct, and as such could be considered as a good index to dental growth in the canine species. As for the possibility of influencing the process of evolution, it was of course generally known that quite a lot of " camouflage " went on in the grooming of dogs for exhibition purposes ; for instance, certain breeds of dogs were supposed to have stiff ears, but if certain specimens failed in this respect the ears were sometimes bound up with sticky plaster on cardboard splints, and, about an hour before the show, the plaster was stripped off and the ears massaged so that they became erectile, and appeared naturally stiff ! Again, a breed of German sheep dog, if perfect, had ears that lapped over, and this appearance could be secured by sticky tape secured to each ear and passed under the neck. The appliance of which Mr. Watkin had spoken was used for one of the " schnoutzers " to raise the bite, and not for active tooth movement. Mr. Heald had raised a pertinent point in regard to fees, which in the case under review were modest ones, and rightly so, as in the first instance the chances of doing good were quite problematical, and although in fact the case turned out well, it might equally have not done so. Only by experience can the orthodontist assess his responsibilities in respect of a case, and accurately define the possibilities that may accrue from correct treatment, and for such services large fees were rightly payable, but in the case under review he (Mr. Cutler) felt very much like the novice orthodontist tackling his first case !

ROENTGEN STUDIES IN CASES OF MALOCCLUSION, FROM THE ARTICLES OF E. BUSTIN AND M. LEIST.

By Mrs. L. Lindsay, L.D.S.

Mrs. Lindsay said that Dr. Leist asserted that every extraction of a milk tooth led to an anomaly in the permanent dentition. He based this assertion on the X-ray pictures which he had been fortunate enough to observe in great numbers. He went further, and said that a normal X-ray picture of a milk dentition was a rarity in hospital practice. Caries also had the same effect as extraction, in that by destruction of the crowns of the milk teeth, loss of space, needed for the succeeding teeth, resulted. Extraction of the milk molars was to be deprecated, especially in the third and fourth years; the germs of the premolars were likely to be extracted with the milk molars because there was a connective tissue bond between them, the germs being clasped tightly by the molar roots. This could be seen in the X-ray illustrations. It was a moot question whether the reputed frequent absence of the germ of the second premolar was not due to early extraction of the second milk molar. After the extraction of the D the displacement distally of the 3 might be observed, often as far as the mental foramen, whilst the E did not move mesially but always distally, thus leaving the gap in the place of D. After the extraction of E, 6 moved mesially, and the root of D was displaced distally but did not pass beyond the mental foramen, which appeared to set a boundary to the movement of the D.

In these studies of anomalies of position in the temporary dentition, the fact emerged that what was considered as a true case of Angle Class III, from the clinical point of view, may prove to be what the authors term a "symptomatic" Class III. The cases of symptomatic Class III might be divided into two categories: (1) malocclusion present in the milk dentition; or (2) arising after the eruption of the permanent teeth. If the former, the X-ray picture will show a gap between the E and the unerupted 6. This gap was generally accounted for by some habit on the part of the patient, such as jerking the fingers out of the mouth after having fixed them upon the lower incisors. In these cases the upper and lower sixes had a marked mesio-occlusion, a secondary condition, since these teeth had originally been in normal relation, but owing to the habit referred to, the lower teeth had been brought forcibly into mesio-occlusion. Should the symptomatic Class III arise after the eruption of the permanent teeth, there would be a gap seen in the X-ray picture between the erupted lower six and the germ of the lower seven. When the front teeth met in edge-to-edge bite, this was due either to the fact that the six-year upper and lower molars occluded in an incorrect position, or that the lower centrals erupted before the sixes. It was to be observed that the lower first and second bicuspids were pushed against the distal roots of the lower first and second milk molars. Retraction of the lower centrals resulted in the elimination of the space

between the lower six and seven. It was possible only by means of the X-rays to determine whether the case were a true or symptomatic Class III; there was no gap in a true Class III. It might be suggested that this gap was physiological, but the authors asserted that they had never seen it in any case where an adequate reason for its presence could not be given, such as anomalies in position, or as the result of extraction; besides the gap always presented behind the last erupted tooth and the germ behind it enclosed in the jaw. Curiously enough the cases of Class II met with by Drs. Bustin and Leist were fewer than those of Class III. In the X-ray pictures of these cases the unerupted bicuspids were situated more towards the mesial roots of the first and second lower milk molars than towards the distal roots; this condition was never found in cases of Class III nor in any normal cases. It arose, therefore, from this research work that the X-rays were not only useful but indispensable in diagnosis and also in prognosis, for it was obvious that in cases of symptomatic Class III, where a gap existed, the result of retraction was bound to succeed, but that where no gap existed, as in true Class III, the anomaly was due to growth of the jawbone and the hope of success as a result of simple treatment was remote.

Discussion.

Mr. G. Northcroft took it that Mrs. Lindsay was speaking for the authors and not for herself when she said that because of the early extraction of the deciduous teeth the roots of 4 and 5 in the last case would not go on growing. He had never heard of such a theory before, and, frankly, he did not believe it. He was sure that the apices of these premolars would go on growing and the foramen close up. He did not see that there was any reason for supposing that because the deciduous teeth were lost prematurely the growth of the roots of the permanent teeth would be affected. Their position might be altered, but not the growth of the teeth themselves. He had been interested in the series of extra-oral films, because they were similar to those which he had studied for the purposes of the investigation on the "Princes in the Tower." When studying a number of X-ray pictures in connection with the eruption of teeth he was particularly struck by the tremendous difference there was, both in the position of the forming crowns in their crypts and in the ages at which the teeth erupted and the different ages at which the roots of the deciduous teeth were absorbed, also in the marked variation that there was in the ages at which the roots of the second molar were developed.

Mr. H. G. Watkin said that he had several cases where the early loss of the mandibular first molar had been followed by the drifting backwards of the mandibular second premolar. He could not account for it, but it was certainly not due to occlusion. There was one other important point. Mrs. Lindsay laid stress on the necessity for preserving the deciduous molars. In Liverpool recently they had had one investigator who had been taking particular notice of what happened when the deciduous molars were extracted round about the age of 4 or 5, and it was found that in some cases the tooth germ of the succeeding tooth had come away between the roots of the

carious deciduous molar. It appeared to him very likely that when, later, the tooth was said to be absent, the fact was that the germ had been extracted with the deciduous tooth.

Miss K. Corisande Smyth mentioned two cases which she had lately seen that had been brought to mind by what Mrs. Lindsay had said. First of all, in connection with the two groups of Class III, the symptomatic and the true, so far as she could remember Mrs. Lindsay's statements, the symptomatic ones were characterised by the spacing of the teeth and the true ones by contact of the teeth. She wished to ask in which category one could place those cases that were obviously too long in the mandible. Those were associated with actual spaces between the premolars and the canines and the molars. There seemed to be too much length of bone together. She had always thought that these were examples of true inferior protrusion cases, but that did not seem to fit in. In one private case, a boy of ten, the patient had already had the four first premolars extracted, and there was a tendency to an extra length of mandible even at that time. With regard to the extraction of the teeth, that was out of her hands, the extractions were done, the spaces were there, and she did nothing to the lower jaw, but a great deal of expansion to the upper jaw. There was a quite reasonable overlap of 1 or 1½mm. of the maxillary incisors, but during the two and a half years she had been treating the case the lower arch had come forward at a tremendous rate, and not only had the spaces completely closed in the lower arch, but the second premolars were now obviously pushing the canines over the laterals, and the whole arch was shifting right forward. In desperation that very day she had put a little splint on the upper canine which engaged in the space between the lower canine and premolar. But all the back teeth were in contact, and there seemed to be a crowding up of all the teeth in the mandible, and this protrusion was increasing in spite of the loss of teeth. In connection with the loss of deciduous teeth, she had always been taught that it was very important to retain them for the purpose of keeping spaces for the permanent teeth, and if they had to be lost it was very important to put in some kind of splint to retain the space. While she had been talking about this very thing a case turned up at hospital that she had not seen for three years. It was a case in which treatment had been proposed, but owing to financial difficulties the case had been lost sight of. It now came forward three years later. At the age of eight the boy had lost all his deciduous teeth ; he was a distinct Class II case, with a very small mandible and mandibular arch, and she had intended to insert a splint plate in the lower arch to retain the spaces. When the boy appeared, after three years with no treatment, models were taken, and it was found that all his lower premolars had come into place quite regularly and properly, with no loss of space at all.

Mr. Robert Cutler asked whether the symtomatic cases were characterised by a marked family history.

Mrs. Lindsay : No, not those, the true ones.

Mr. Cutler said that he thought the work which Mrs. Lindsay had brought forward was of tremendous value to them in deciding

as between true Class III cases and symptomatic Class III, which he (Mr. Cutler) called Division 3, Class I. Another important point of differential diagnosis was that the symptomatic Class III cases always looked very much better—either in profile or in the general facial ensemble—than one would suppose from the plaster cast of the models. On the other hand, the true Class III did the reverse, looking less serious in the models than in actuality.

Mr. HAROLD CHAPMAN said that he had been surprised to hear that certain of these cases presented such difficulty in treatment. He was wondering on what lines the treatment was undertaken, whether it was to move the teeth through the bone or to endeavour to move the mandible itself backwards, and, with the mandible, the teeth. He did not recall the difficulties in moving the mandible distally, or changing the occlusion that, he concluded, the orthodontists in question had had, provided the age of the patients was suitable. His own endeavour had been to move the whole mandible back rather than the teeth through the jaw. He did not see what the difficulties were unless there were some factors which were not apparent in the X-rays.

The PRESIDENT said he understood Mr. Watkin to refer to the necessity of preserving the deciduous dentition even to the point of draining a septic tooth—he felt that he could not quite mean that. As one who was responsible for some 500,000 children in the London area, his own principle was that if a tooth could not be made healthy it should be removed, but there was material in that alone for an evening's discussion.

Mrs. LINDSAY, in reply, said that she was afraid she had not made quite clear the difference between the symptomatic case and the true. In the former the gap was always between the last erupted tooth and the tooth lying in the jaw behind it, and the prognosis was always favourable. But where the gap lay in front, as Miss Smyth had mentioned, then that was a true Class III. If there was no gap behind the last erupted tooth the prognosis was unfavourable, and, in fact, putting appliances on such a case seemed to add to the trouble and stimulate the growth to more activity. Mr. Northcroft had mentioned the question of the growth of the roots; that, of course, was the authors' statement, especially in the third case of extraction, where the $\overline{\text{D}}$ was extracted early, and only the crown had erupted. She had once taken out a tooth of that description in an adult and was afraid that she had left the remains of the tooth in the jaw; the root had evidently had some check and was arrested in development. Dr. Friel had shown her a case in which he was afraid that his treatment had caused absorption of the root, but she was not of that opinion, and she thought the case was of a similar nature to the one shown in the X-ray. Mr. Watkin had spoken about the retention of the deciduous molars. She had always kept the deciduous molars as long as she could, but, of course, in a clinic one could not see the children often enough to be sure that the roots were drained. In a school clinic she was sure that would not be the right thing. With regard to extracting the germ of the oncoming tooth, she had experienced that misfortune herself. Once she extracted a lower $\overline{\text{E}}$ and thought it was an abscess at the end of it, but it was the germ which came out with it. That was in a child of four. She thought she had

already answered Miss Smyth's questions about the spaces. She was sorry that she had not made it clear about the symptomatic and the true, because the former was the favourable condition, and it could only be diagnosed by X-rays. It was found when there appeared a space between the last erupted tooth and the tooth in the jaw immediately behind it.

On the motion of the PRESIDENT a hearty vote of thanks was accorded to all the readers of the papers and the meeting terminated.

THE DEVELOPMENT OF THE MANDIBLE.

By S. Wilson Charles, L.D.S.,R.C.S.Eng.

It has been shown in previous papers that the mandible in the human fœtus grows by additions to the base of the wedge of bone which appears about the 55 mm. stage of interuterine life, and that growth at the angle and coronoid is subsidiary to the main line of growth of this wedge which is in an upward, backward and outward direction. As growth proceeds the general level of the tooth sacs is raised relative to the main line of growth. Any obstructing bone at the base of the coronoid is removed as the tooth sacs move upward and forward or is involved in the general upward, forward and outward growth of the tooth sacs and alveolar bone (Fig. 1B).

The evidence in favour of these conclusions was first published in 1925 in a paper "The Temporo-Mandibular Joint and its Influence on the Growth of the Mandible" (*B.D.J.*, July 15th), and may be summarised as follows: Ossification in the mandible begins about the 18 mm. stage and is preceded by a condensation of cells in the neighbourhood of the future bone. This is followed by a simple differentiation of these condensed cells into bone (Fig. 2). About the 50 mm. stage a change takes place at the distal end of the bone. Under its thickened and condensed connective tissue, layers of cartilage cells appear which are rapidly converted into bone (Fig. 3). The mandible being a membrane bone will be formed for the greater part by the direct differentiation of primitive cells into bone, but in certain places where more rapid growth is required there is an intermediate cartilaginous stage. This accounts for the regular appearance of these cells at the condyle and their irregular appearance at the angle and coronoid process. This rapid proliferation of cells at the distal end results in the appearance of a wedge-shaped mass which eventually approximates with the under surface of the temporal to form the temporo-mandibular joint. The wedge appears to be cartilaginous, but microscopic examination shows that it is bone with cartilage cells at the distal end only (Fig. 4). These cartilage cells are not removed by a process of invasion; they are ossified independently. There are two definite proofs. (1) Bone formed in membrane direct and bone formed with an intermediate cartilaginous stage are microscopically different in appearance. They can be seen side by side in the same section and there is no possibility of confusing them (Figs. 5 & 5a). So marked is the difference that a sharp line of demarkation can be seen with the naked eye in a stained section (Fig. 4). (2) Fœtal jaws which have been cleared so that they are translucent, show this wedge invaginated into the

body of the mandible. In the young fœtus it appears as a light strip in a darker mass, but in older jaws it appears as a dark strip in a lighter body.

Growth continues to take place at the distal end of the condylar process, and the body of the bone, which is at the other end, is pushed downward and forward; the condyle itself growing upward, backward and outward. If no other growth took place this would result in a body with a long wedge attached to it, but as the wedge grows so does the bone of the body and ascending ramus advance and envelope it. It is as if there were two entirely different substances moving in opposite directions, the one, the growing condyle, pushing the body of the mandible downwards while the body itself grows upward around it. Actually the condyle is added to and the continuity of the whole bone is maintained by the upward and backward growth taking place in front of the condyle and behind it.

The examination of large numbers of serial sections shows that growth is taking place in front of the condyle and coronoid, and that there is no mass absorption with the exception of slight modelling absorption (Fig. 6). This is in direct opposition to the findings of Kölliker, who claimed to have demonstrated that extensive absorption took place in front of the coronoid and condyle in the human fœtus. Now, as there is bone growth and not absorption in front of the condyle, and the mandible grows by elongation of the wedge with an upward enveloping growth of the simple bone in which it is embedded, it follows that the continuity of the wedge is maintained. The alveolar border and enclosed tooth sacs make a definite angle with the main line of growth of the condyle and, as the alveolar border increases in height and as (1) the distance from the incisor region to the front of the coronoid and (2) the distance between opposite teeth also increases, it follows that the teeth must move upward, forward and outward.

It now remains to be seen how far this is applicable to the mandible of the growing child. This has been done by examining animals during growth and correlating the results with those obtained from the examination of human mandibles and the measurements of living children.

Previous to the commencement of ossification in the mandible of the human fœtus, there has been a differentiation of the ectoderm which results in the formation of the dental lamina and, eventually, the buds of the deciduous teeth and first permanent molars. The mandible rapidly becomes trough-shaped, having the inferior dental artery and nerve towards the floor, with the dental lamina and tooth buds suspended from above (Fig. 7). The enamel organ of each tooth becomes bell-shaped and the mesoderm in the neighbourhood of each bud develops to form the dental papilla but, as growth progresses, the surrounding undifferentiated tissue grows up and completely envelops it. The vertical depth of the lamina increases, i.e. the tooth buds come to lie more deeply, but this is due to the upward growth of the alveolar borders with the contained connective tissue; it is not due to the ingrowth or

invagination of the original ectoderm or tooth bud. This point is of importance especially in the development of the second and third molars, for they appear often to bury themselves more deeply in the body of the mandible as development proceeds, whereas the appearance is due primarily to the upward growth of the alveolar borders and other contained tissues.

The tooth buds now lie in close relationship with the inferior dental system, which is itself fairly close to the lower border, though with a hollow space in the bone underneath. This space is connected with a foramen underneath the border of the mandibular foramen. There is at this stage no bone between the tooth sac and the inferior dental nerve, and the dental lamina still connects the tooth bud with the mouth (Fig. 8). Growth is proceeding rapidly at the two alveolar borders, so that both grow upwards, while absorption is taking place all round the tooth sac and nerve as they also grow. In the region of the posterior part of the second deciduous molar and the anterior part of the first permanent molar, growth is taking place on the inner alveolar border and along the whole of the coronoid process. Absorption is taking place all round the tooth sacs and under the base of the coronoid, cutting away the overhanging portion as the tooth sac moves upwards, while the distal end of the dental lamina is seen lying in the connective tissue above. Above and to the side are nerves and blood vessels which are not clearly seen in sections toward the front, but becoming very definite toward the distal end of the body of the bone. At the same time as the vessels become more definite, the inner alveolar ridge and base of the coronoid come together, so that they bridge over the distal end of the open trough enclosing, in a large canal which leads to the future mandibular foramen, the posterior part of the last tooth bud or sac, with the inferior dental system below and the system of arteries and nerves just mentioned, above. This upper system arises from the inferior dental system outside the mandibular foramen and is of some importance, for the buds of the second and third molars are developed along its course. It will for this reason be called the developmental system.

As soon as the sac of the first molar appears, the developmental system is seen to pass over its posterior wall, which is at this stage in the canal at the distal end of the open trough leading to the mandibular foramen (Fig. 9). Later the posterior part of this canal is constricted so that there is a bony wall behind the tooth sac with a single narrow perforation for the passage of the two arterial and nervous systems. This perforation is in turn constricted until there are two foramina in the posterior wall with a narrow opening between, i.e. the foramina are not completely shut off from one another. As growth proceeds the foramina are completely separated. The mandibular foramen itself is now seen to divide into three foramina, the large one for the inferior dental system, the small upper one for the developmental system, and another below which leads to a canal running underneath the inferior dental canal. This canal will be discussed later (Fig. 9). Between the large foramen and the upper one is a strip of bone which develops from the posterior wall of the canal at the distal end of

the mandibular trough into a bony mass which grows upward and backward as the mandibular foramen grows. By reason of this growth the developmental foramen eventually lengthens into a canal running from the mandibular foramen to a foramen on the anterior surface of the coronoid. The presence of these foramina and canals can be demonstrated in serial sections and by the passage of wires in dried specimens.

The general principles of mandibular growth in the human fœtus described in this paper apply with certain modification to many common animals. There is the same cartilaginous bony growth at the condyle, which method of growth persists after birth as it does in the human mandible (Fig. 13). This is especially marked in the rat, and indeed it is obvious from a comparison of developing mandibles that they could not possibly have developed except by growth at the condyle itself, with growth of an entirely different kind along the posterior border (Fig. 9a). In the pig there is marked cartilaginous bony growth at the condyle. This, however, differs from man in the direction of the lines of blood vessels in the cartilaginous bone. In man these vessels are usually at an angle of 45 degrees with the horizontal, but in the pig they make a much more acute angle which may be as low as 30 degrees. This is probably due to the greater forward growth in the pig's mandible, in which there is evidence of some absorption on the front of the coronoid, though this is, in all probability, little more than ordinary modelling absorption.

No attempt has been made in this investigation to inquire into the very early fœtal development of the pig, but the work which has been done does not suggest that there is any serious difference of principle in the development of the mandible of the fœtal pig and of the human fœtus. At birth there is not the same constriction of the distal end of the mandibular canal, and the sac of the last tooth lies in and partly outside the mandibular foramen proper, with the inferior dental system underneath and the developmental system above. There is a bony floor underneath the deciduous molars but only the commencement of ossification of the floor of the crypt of the first permanent molar. The space under the bony floor of the tooth sacs is large and carries the inferior dental system and is probably filled with marrow as in older specimens. This cavity differs from that found in the human fœtus, for here it actually contains the inferior dental system, but in the human fœtus is separated from it, having a separate foramen as entrance. The foramen on the anterior surface of the coronoid has appeared and continues backward as a shallow groove on the under surface of the coronoid inside the large mandibular canal. As the pig develops, the developmental canal takes definite shape, due to the extension backward of the bony covering of the tooth sac. This develops into a bony mass as in the human mandible, though in the case of the pig it definitely projects through the mandibular foramen and forms an alveolar bulb which is the counterpart of the alveolar bulb found in the maxilla of the pig.

The maxillary alveolar bulb is a projection at the distal end of the alveolar ridge and when developed, lodges the sacs of the

THE DEVELOPMENT OF THE MANDIBLE

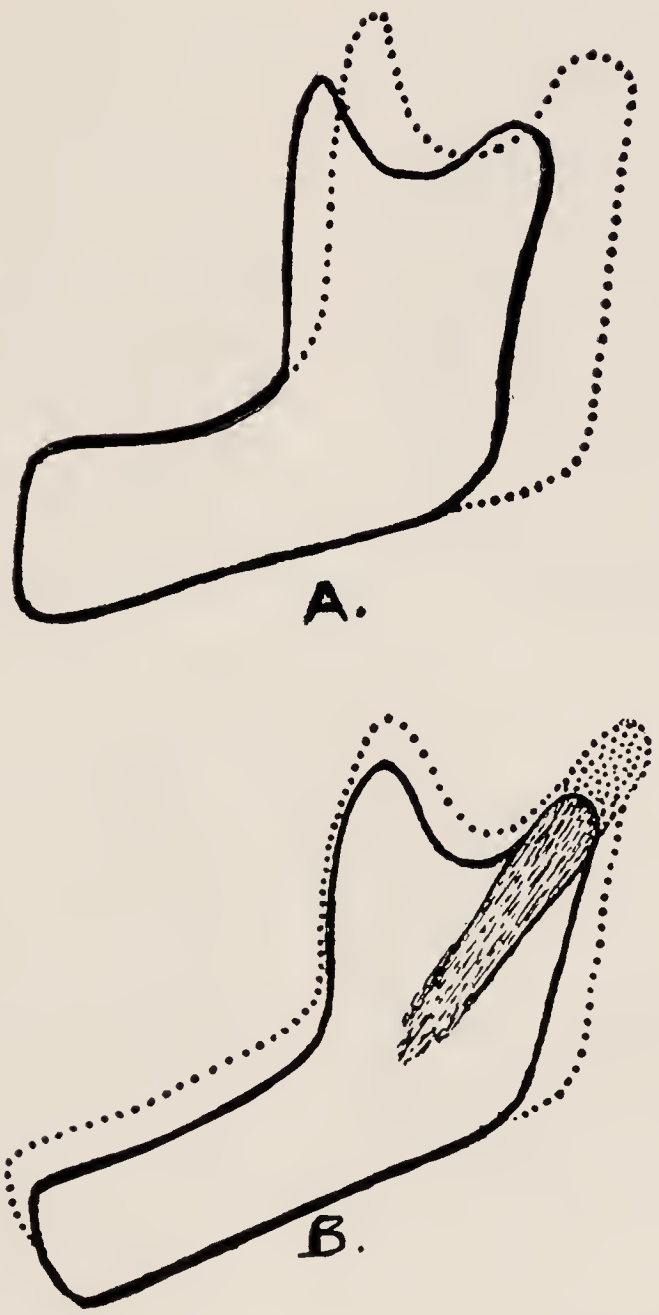


Fig. 1.

Illustrating Mr. S. WILSON CHARLES' Communication.

Fig. 2.

Fig. 3.

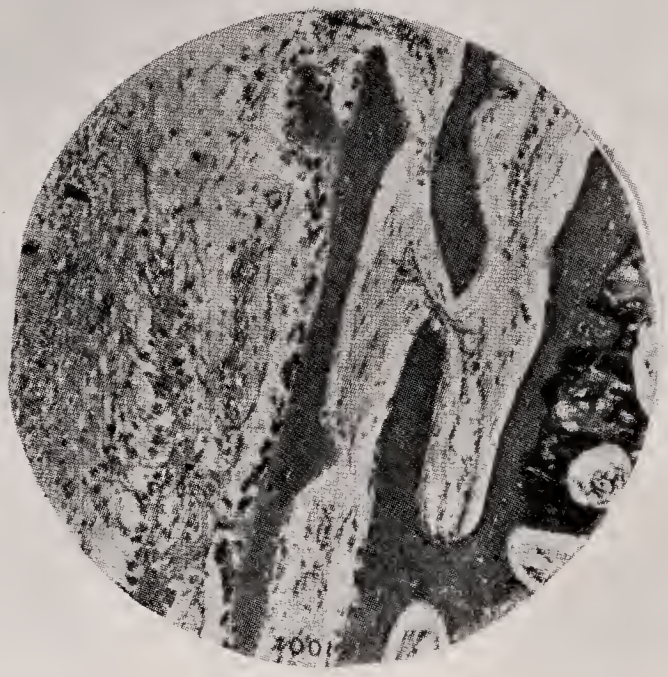


Fig. 4.

Fig. 5.

Fig. 5a.

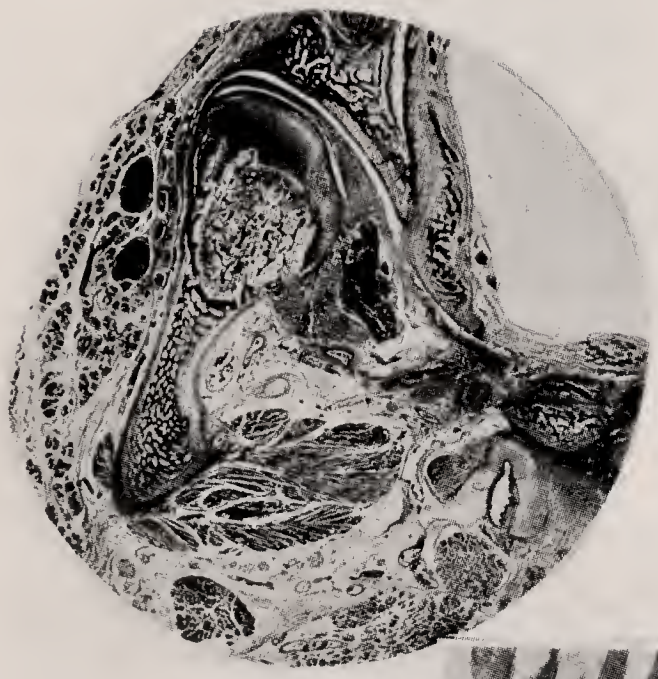


Fig. 7.

Fig. 6

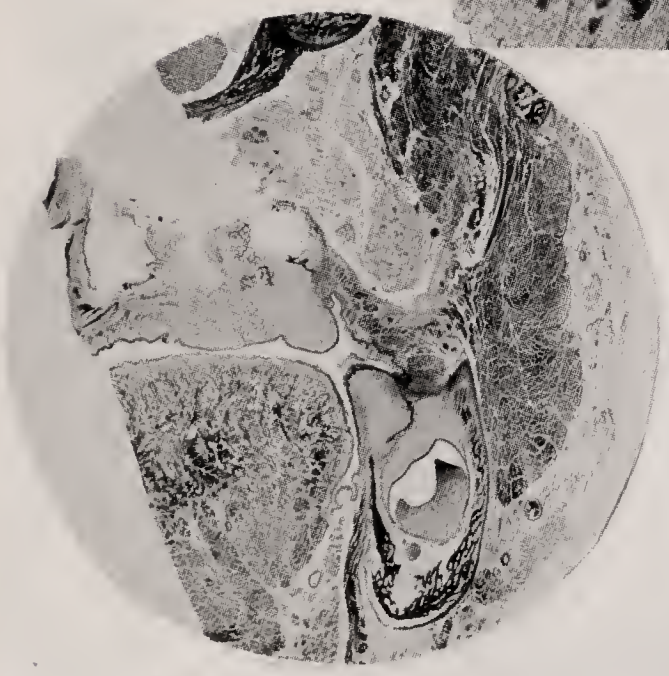


Fig. 8.

Fig. 9.

Fig. 9a.

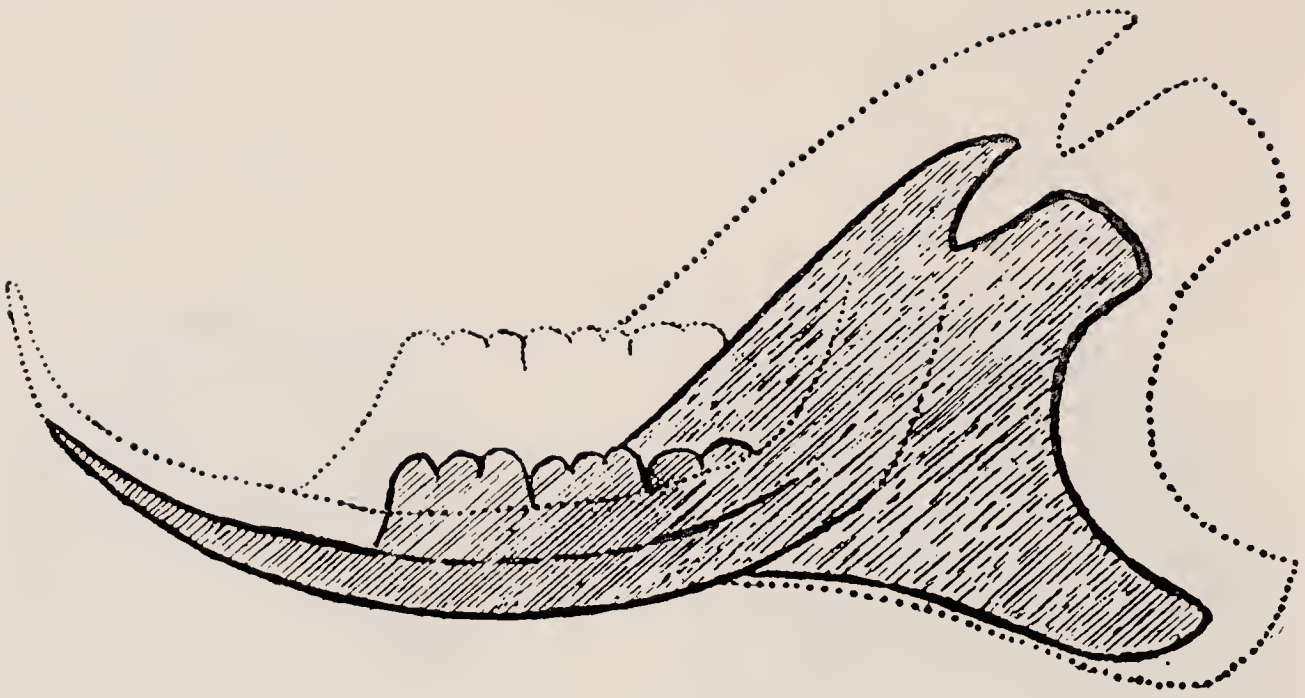


Fig. 10.

Fig. 11.

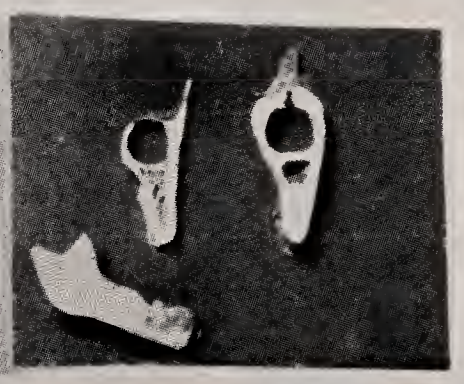


Fig. 12.

Fig. 13.

permanent molars (Fig. 10). The maxillary nerve in the pig lies directly over the crypts of the teeth and passes under the antrum, not over it as in man. At birth the last deciduous molar lies in a crypt of very thin bone with the sac of the first permanent molar behind and above, as yet not enclosed in a bony crypt. It is bounded above by the maxillary nerve, behind by the great wing of the sphenoid, and on the inside by the palatal bone. There is no bony boundary to the under surface and the sac itself is attached to a developmental system which comes from the maxillary nerve. The sac is gradually enclosed by the bone of the maxilla which extends from the crypt of the deciduous molar, and this extends further back to form a bony projection pointing upward, backward and inward in which the sacs of the second and third molars develop. The under surface of the bulb is now a flanged groove which opens into each tooth crypt and is lined with a glistening fibrous covering which is continuous with the pereosteum of the bone. The groove itself contains a fibrous sheath containing blood vessels and nerves (the developmental system) which is attached behind to the sheath of the maxillary nerve and in front to bone at the back of the first molar and its connective tissue covering. By the dissection of the firm fibrous attachment behind the first molar it is possible to free the end and shell out the tooth sacs from their crypts. It is then seen that each sac is firmly connected with this sheath and not with the crypt. Microscopic examination shows the continuity of the blood vessels of the sheath and the tooth sac and, in some cases, the presence of the double layer of epithelial cells which have been derived from the distal end of the dental lamina, and from which the enamel organ of the molars has been formed. It is of interest to note that the mesoblastic tissue from which the dental papila has been derived can only have been derived from this sheath, for the second and third molars arise as a slight thickening of the sheath in the bony grooves of the alveolar bulb.

In the mandible, the bulb is embedded in the dense bone of the ramus, and is not so obvious. Its development is exactly the same, with the exception that the sac of the last developed molar is not bounded, as in the maxilla, by the sphenoid and palatine bones before ossification of its crypt, but by the mandibular foramen and the large canal leading to it. Prepared older specimens show exactly the same appearance as in the maxillary bulb, with the developmental sheath lying in the canal and with the sacs attached to it. It is obvious from a comparison of human and pigs' mandibles that the second and third molars are developed in the same manner, and it is difficult to resist the conclusion that the developmental sheath plays an important part in the growth and eruption of the tooth sacs. Professor Brash has brought forward evidence to show that the eruption of the teeth is the result of bone growth, but there is some evidence, apart from the presence of the developmental sheath, to suggest that eruption may be caused by other factors besides bone growth and that bone growth may be secondary to tooth movement; the tooth, in other words, may be moved by some agency and the bone grow up to consolidate the position. In the case of the permanent molars, the develop-

mental sheath is firmly attached to the bone and connective tissue behind the last molar, and as the tooth moves upward and forward and the mandibular foramen backward and upward, it is obvious that the developmental sheath and attached tooth sacs must be carried upward and forward.

The examination of sections shows that the upper part of the developmental canal is being absorbed and that the tip of the alveolar bulb is growing upward, backward and outward. This growth is somewhat less than the growth of the mandibular foramen, for the bulb ceases to protrude from the foramen when the third molar crypt enlarges. It will be seen that the second and third molar crypts are buried much more deeply under the coronoid than are the corresponding molars in man (Fig. 11). There must be, for this reason, much more forward movement of the teeth themselves to release them from the base of the coronoid so that they may erupt. The first molar, when rising into its position in the arch, goes through a complicated series of movements. The distal end is tilted downwards as if it were trying to slide under the arch formed by the coronoid (Fig. 12). At the same time it rotates but only sufficiently to permit it to come into line with the last deciduous molar which is moving upward, forward and outward, i.e. it rotates round its own centre or posterior border and not round its anterior border. At the same time the crypt for the second molar enlarges, the necessary space being provided by the upward and forward growth of the first molar. The crypt for the third molar appears as a depression in the developmental canal above and behind the second molar crypt and the space for the enlarging crypt is provided by the forward movement of the second molar crypt and the backward movement of the tip of the alveolar bulb.

Microscopic examination shows that active growth is taking place at the condyle, tip of coronoid and the posterior border; that the tip of the alveolar bulb is growing upward, backward and outward, though at a slightly less rate than the mandibular foramen which eventually completely encloses it as in man. The measurements made of mandibles of different ages indicates the general direction of bone growth. In the four specimens shown the distance from the mesial surface of the first permanent molar to the apex of the alveolar bulb is increased from 45 mm. to 65 mm., the distance from the alveolar bulb to the lower border from 37 mm. to 48 mm. The distance of the tip of the anterior buccal cusp of the first molar from the lower border increases from 34 mm. in the first specimen to 49 mm. in the last. The angle of a line drawn through the centres of the tooth sacs is, in the first specimen, at an angle of 40 degrees but in the last at an angle of 20 degrees. The distance from the condyle to the tip of the alveolar bulb also increases, but the rate of increase is not equal to the rate of growth of the condyle itself. The diagram based on these measurements shows that, though the tip of the alveolar bulb and the mandibular foramen move backward and upward, the teeth move upward and forward.

In a paper published in the *Transactions* of the B.S.S.O. in 1926,

Professor Brash states that the necessary space for the erupting molars in front of the coronoid is obtained in three ways :— (1) By the raising of the teeth in the growing alveolar border in relation to the backward sloping anterior border of the coronoid. (2) By an upward and forward growth movement of the teeth themselves in the bone as evidenced by continuous reformation and adjustment of the walls of the alveolar cavities. (3) To a very minor degree (and not, as formerly supposed, principally) by absorption of the anterior margin of the coronoid.

These conclusions were based on observations and measurements of the mandibles of madder-fed pigs, and are important to this investigation because they show by another process of reasoning that the mandible does not grow by deposition of bone at the posterior border with mass absorption in front of the condyle and coronoid, but that the teeth move forward and upward relative to the main line of growth.

The madder method has been used on many occasions for the elucidation of the problems of mandibular growth, but a different interpretation from that of Professor Brash's has always been given. This old interpretation was supported by the microscopic investigation of Kölliker but, as has been stated earlier in this paper, these results are at variance with the results of microscopic examinations described here. There does not, however, appear to be any logical reason for doubting that the madder specimens do indicate bone growth with a fair degree of accuracy, and that Professor Brash's conclusions and those enumerated in the beginning of this paper, for growth in the human fœtus, confirm one another.

The measurements of dried human mandibles based on the principles laid down show that the method of growth for the human fœtus continues after birth and, with modifications, may be considered to be the method of growth of the child's mandible. These results are confirmed by measurements made on living children, and especially by measurements of children made at different ages. It is hoped to publish these measurements and the description of the method adopted for making them in the near future.

The human mandible may be said, therefore, to grow primarily by additions to the condyle, the bone in front of the condyle and behind growing in such a manner that the continuity of the bone is maintained. In relation to this main line of condylar growth, the teeth and alveolar ridges are always in a state of movement, travelling (in relation to condyle growth) in a forward, upward and outward direction. It follows that the suggestion that the arch formed by the successional teeth is the same as that formed by the deciduous teeth is incorrect, except in so far as concerns the actual length. It cannot be too strongly emphasised that the teeth are in constant movement relative to the main line of growth of the mandible, even though they may keep in positions which are fixed relative to one another and that in whatever direction the orthodontist may move the teeth they are themselves always moving in the direction of their normal growth.

Discussion.

Dr. G. Northcroft congratulated Mr. Charles on his excellent paper and his presentation of it. He was very glad to hear Mr. Charles say that it was right to assume that there was a definite movement forward of the teeth through the growing bone; that was an idea that he had himself held for some time. He was also very interested to hear that Mr. Charles approved in the main of the idea that the demonstration of growth of the mandible of madder-fed pigs was of value. He thought it was generally recognised that the pig's jaw grew in a somewhat different way from that of the human jaw, having naturally a greater forward growth than the human jaw had, but he thought Mr. Turner was certainly wrong in so very definitely saying that Professor Brash's conclusions were entirely unwarranted. Personally he considered that Professor Brash's investigations had been of great help, and he thought that Mr. Charles had thrown further light on a very difficult and abstruse problem. Some of the slides that Mr. Charles had shown were of great interest, and he supposed that Mr. Charles had a large number of serial sections, which would add to the value of the whole work, though they could not, of course, all be displayed at the meeting.

Mrs. Lindsay said that Mr. Charles said that the teeth grew upwards and outwards, but surely he meant inwards. They could not grow outwards into the coronoid process, so she supposed he meant that the molar teeth inclined inwards. There was a Fiji mandible at Russell Square in which the posterior teeth were quite distinct from the coronoid process. They looked as if they were in a separate development of the bone or an outgrowth of the bone. It was a confirmation of Mr. Charles's contention that the anterior border of the coronoid process was not extensively absorbed, because in the case she had mentioned there was no necessity for it; the teeth were right inside it and forward from it. Mr. Charles mentioned that underneath the crypt of the tooth, absorption was going on, but she had an illustration of a section of a growing tooth in the crypt where there were alternate layers of deposition and absorption of bone underneath the root. It seemed to prove Professor Brash's contention that it was the upward growth of the alveolar bone which brought the teeth into eruption. Again, she had an X-ray picture where the D had been lost and the 4 had passed up without the growth of the root, and there seemed to be a sort of osteoid tissue underneath it. The crown of the tooth was formed, but there was no root, and the alveolar bone did not seem to have been deposited underneath it. It all seemed to show that very little was known about eruption. She was very interested in what Mr. Charles had said about the teeth picking up the nerves and blood vessels. According to Professor Fawcett, the blood vessels and nerves seemed to be lying along the developing jaw. She often wondered whether the blood vessels and nerves grew down from the cranial portion into the jaw, but Mr. Charles spoke of them as growing upwards, as if they were going back. Was there no trace of nervous tissue in the tooth follicle? Eustacius suggested that there were nerves in the tooth follicle and that when the tooth calcified those nerves remained, which might explain the nerves in the dentine.

Mr. Schelling said that the mandibles of pigs had been found useful in the old days when there were no human jaws available. He thought the difference was that in the human being the incisors were vertical, whereas the pig had incisors which projected forwards in the horizontal direction. A very common defect in dogs was to have what was called a pig jaw.

The Chairman said he was sure everyone present would wish to thank Mr. Charles for his paper, in the preparation of which Mr. Charles must have gone to an enormous amount of trouble. The Society was greatly indebted to him for his contribution.

RUSTLESS STEEL APPARATUS.*

By Prof. Dr. Rudolf Schwarz.

Stainless steel can to-day be as easily soldered as gold. Because of this fact, the gold alloys for regulating appliances have been almost entirely discarded. It has long been evident that Wipla metal was specially suited for orthodontic appliances; but the difficulty, indeed the impossibility of, for example, soldering a wire to an arch, deterred dentists from using this metal. Meanwhile, with the co-operation of the Firm Krupp, a hard solder and a flux material have been produced which removed in a flash all the difficulties. The wire material also has been graded to the finest sizes and the polished band material surpasses even platinum in pliability. And yet even if the soldering of stainless steel has now become easy, nevertheless practice and a certain knack, which must be thoroughly acquired, are necessary for a perfect soldering.

New Orthodontic Pliers.

With the new orthodontic pliers, it will be possible for everyone to construct orthodontic appliances in the shortest time. The pliers and their manipulation can be seen on the slides.

The New Lingual Arch and the New Lingual Lock.

The Construction of the Bands:

(*a*) The Work on the Patient:

To-day the orthodontic working dentist no longer buys the so-called clamp-band that has to be put on with a wrench; but he makes a plain band himself. For this purpose, we take a roll of polished band-material, 0.1 or 0.15mm. thick and 5mm. broad. With the pliers, the end is bent over at right angles, about 3mm. Then the band is shaped by hand in the approximate form of the first molar.

Correct Position of the Band-Material in the Mouth.

The band-material is so placed in the mouth that the long end can be drawn forward towards the cheek. In this way we avoid injuring the lips. Take care! The band is sharp! The bent end of the band is first by a pressure of the thumb, and then by the aid of a wooden driver, pushed up on the first molar. One hand pulls firmly on the long end so that the bend lies on the medio-buccal edge of the molar. The lingual side of the band is then polished with a band adapter. Now both ends of the band are grasped firmly with the pliers and sharply folded. The band is then removed and the long end is cut off with the scissors, leaving an end of 2mm.

Construction of a Double Bend.

The other end is cut off to a length of 1mm. Then the 2mm. end is again bent 1mm., the short end is placed in this angle and both are pinched firmly together with the orthodontic pliers (Fig. 1). The resulting double bend is bent over completely on to the band, so that the bend is closed. Now the band is ready to solder.

(*b*) Soldering the Band:

We never use a bunsen-burner. The Wipla metal must be heated only with a fine blowpipe lamp. This lamp is placed so that the flame is directed away from us, burning upwards and

* *Transactions* of British Society for the Study of Orthodontics, 1934.

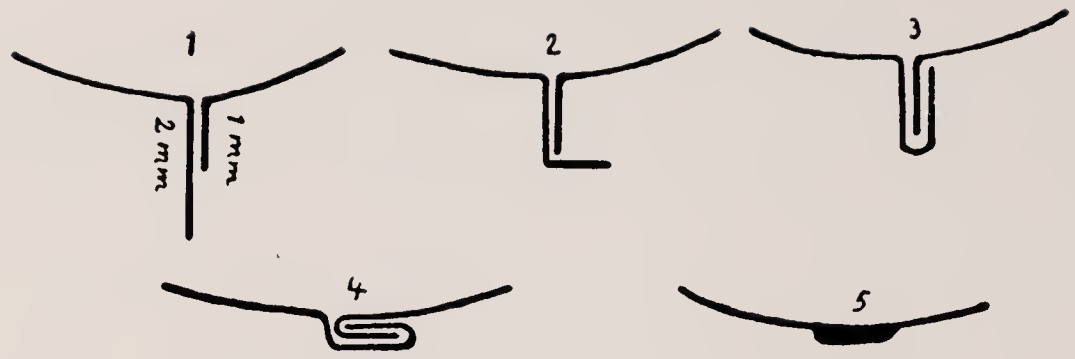


Fig. I

obliquely. When the blowing stops, the flame sinks and we can retain the same hand position for several seconds after the soldering, which is absolutely necessary, as the solder does not harden immediately like gold solder. Never hold the band to be soldered in a quiet flame, because soot will form and soot makes any soldering impossible. We always solder away from ourselves. The only correct position of the hands is accurately shown on the slide. Only a fine needle-point flame 3cm. long must be used and only the point to be soldered should be heated. For a better survey of our work, while soldering the band, we use finely bent soldering pliers. The left hand holds the band firmly with the pliers at a point opposite the bend ; and now the brown flux is applied with a fine spatula (Fig. II). The right hand takes a piece of the thin wire solder and dips it into the brown flux. Now the flame is blown and then only is the band correctly held to the flame. Only the bend is heated, and as soon as this is red-hot the wire solder is drawn over the bend. I might compare this process with painting, for we make perhaps several coats until the groove is completely filled.

Adjusting in the Mouth.

As soon as the second band has been made in the same way, both are adjusted in the mouth, pressed down firmly and polished. Any surplus band is worked towards a corner, gripped with very fine pointed pliers and pressed together. These bends will also be soldered later. And now, the bands in position in the mouth, a plaster cast is taken, preferably with xanthano plaster. The parts of the band visible in the negative are covered with wax, so as to make possible a good separation. The impression is poured, the negative separated, and the working-model is ready. With boiling water the wax is washed away from the bands, so that these can be easily removed.

Soldering the Oval Tubes for Holding the Lingual Arch.

Seamless oval tubes, 2.2mm. long, can be had for wires of 1.0, 0.9 and 0.8mm. in thickness. We strongly recommend for the lingual arch a wire 1mm. in thickness. Such an arch has the correct passive position, is indestructible and makes the best lock. I consider it a mistake to use too thin and too springy a wire. As the finished seamless tubes cannot be absolutely uniform, they must first be pushed over the tube-former, on which the wire loops 1.0, 0.9, 0.8, 0.7, 0.6 and 0.5mm. are fixed and accurately formed with the orthodontic pliers (Fig. III). In this way we are sure that the lingual arch will fit exactly. Now on both bands the points are marked with a file, where the tubes are to be soldered on. Parallel position, as nearly as possible ! Upper and lower models are brought into occlusion and the position controlled.

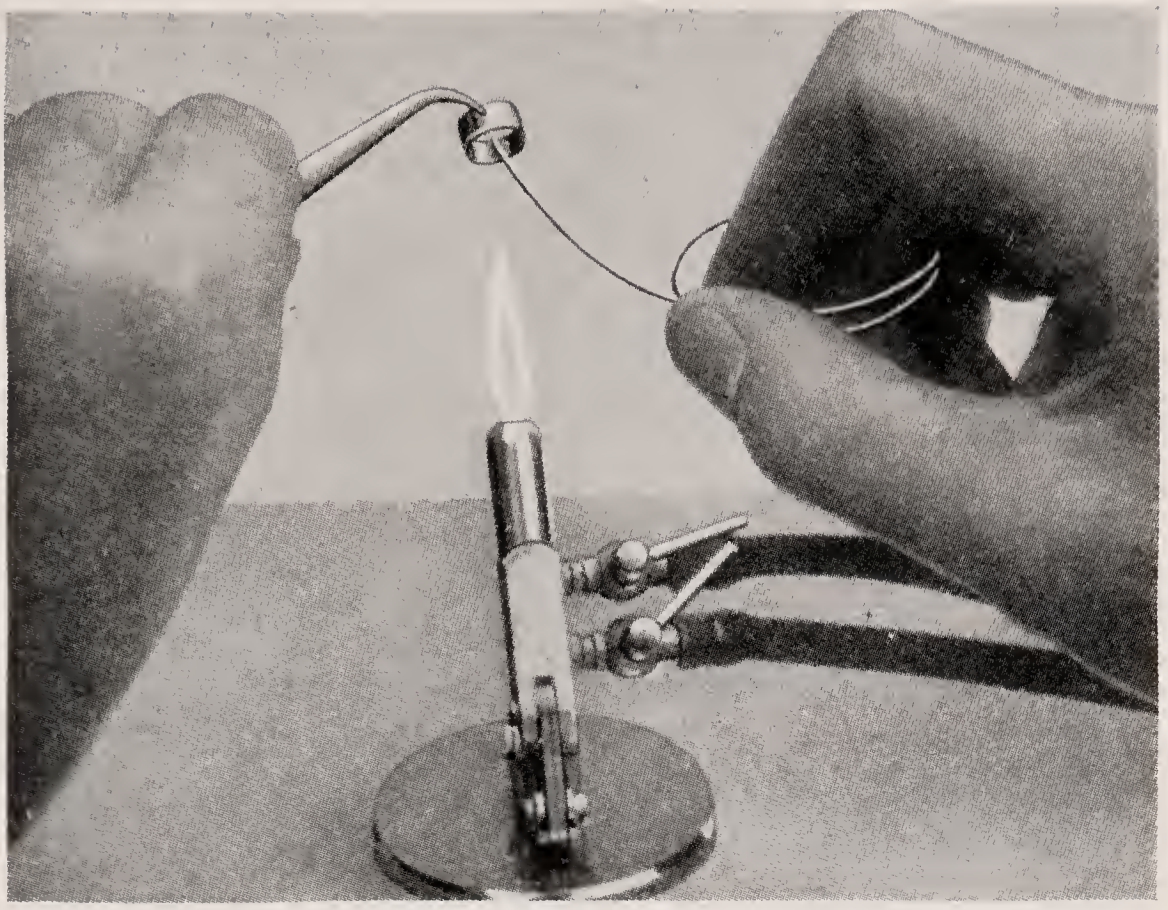


Fig. II.

Position of the Hands.

We use two pliers, a straight one and the bent one described above. The straight pliers in the left hand hold the band at a point opposite the place that is to be soldered. The marked point is slightly heated ; then the brown flux is laid on with the spatula. The right hand now takes the fine wire solder, dips it in the flux, and, heating again, some solder is applied. Now the band is ready to receive the oval tubes. The finely-bent pliers in the right hand grasp the tube at both ends ; it must be slightly warmed in the flame and then the side to be soldered dipped into the brown flux.

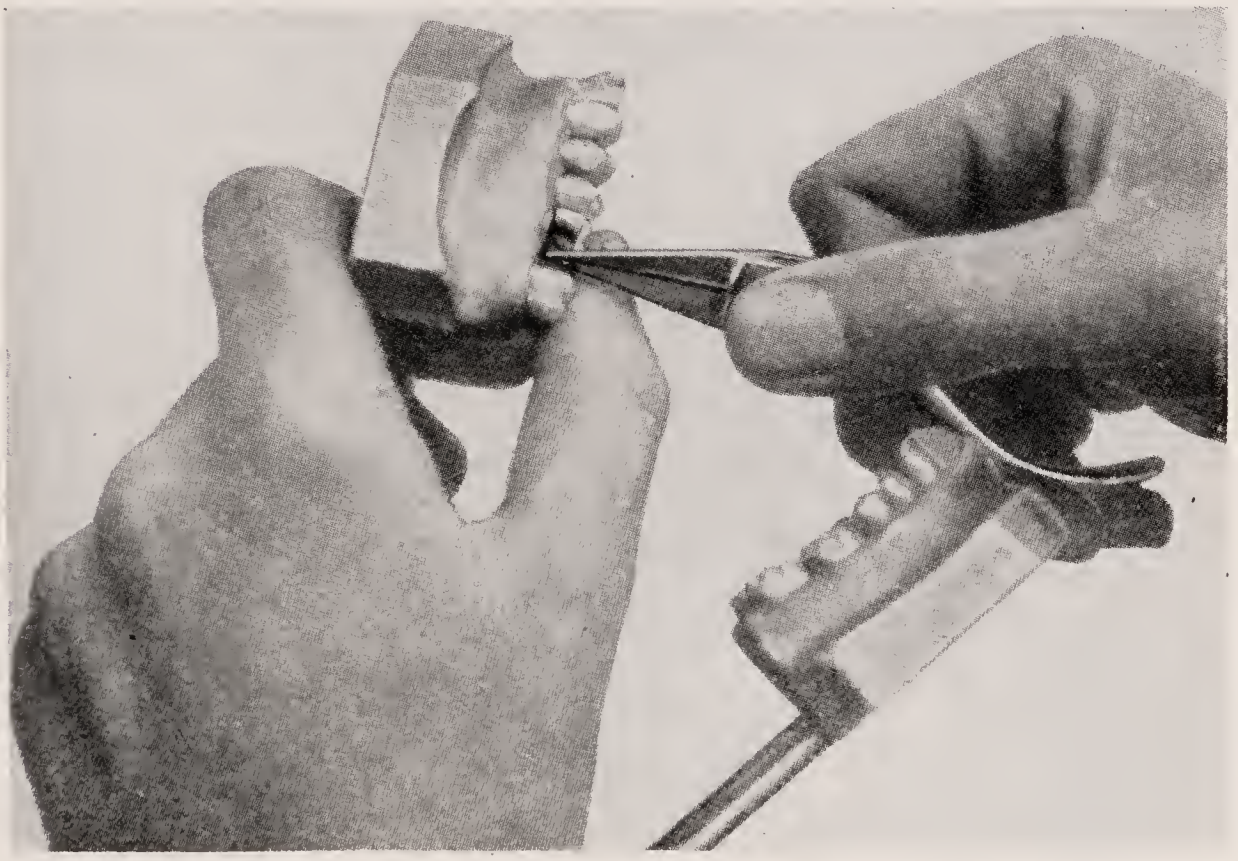


Fig. III.

Now the flame is directed on to the solder which has been smeared on the bend, the tube is carefully laid on, and the two join together. (Fig. IV.) We stop blowing, the flame sinks, and we remain a few seconds in this position. The same technique applies for the soldering on of the rectangular tubes, which we shall describe later.

Manipulation of the Orthodontic Pliers in the Construction of the Lingual Arch.

The soldering of the Mershon lock for fixing the lingual arch and

Fig. IV.

Fig. V.

all its variations used to be exceedingly difficult for the practitioner. With the new orthodontic pliers we can now in a few minutes press a loop-lock, on which nothing has to be soldered. This loop-lock is constructed in the following manner :—

The left hand holds the closed pliers with their perforated pin upright. The right hand grasps the end of a Wipla wire-roll (1.0 or 0.9mm.), so that the right hand is on the right of the pliers and the semi-circular bow lies in their plane. This position is very important for the lock, as in this way we can fully utilize the bending of the wire for the lingual arch (Fig. V). Now the wire is inserted from above into the first hole of the pin (about 1.5cm. wide), after this point on the wire has been slightly heated (1 second red-hot), and completely bent over the pin forwards and downwards (Fig. VI). The wire is removed from the pin, the pliers taken in the right hand and opened. The left hand holds the bent loop and presses it firmly down as far as the shelf, into that hole in the jaws of the pliers which corresponds to the thickness of the wire. The loop must be exactly 5mm. long. If it is not completely pressed down, it will be shorter and will not hold so securely. The sizes of the holes are indicated on the pliers. With a strong pressure of the right hand the pliers are closed, the left hand holding the protruding loop. Then the handles of the pliers are pressed together as strongly as possible with both hands. The right hand lets go, bends the protruding ends of the wire over, takes a little hammer and hammers them on the top of the closed pliers, lightly but accurately. The result is a clean, elastic loop. Now this is slightly heated (1 second red-hot) before forming the wire into the lingual arch. For this purpose the loop is inserted into the perforated pin : wire of 1.0 and 0.9mm. in the first hole ; 0.8 and

Fig. VI. (See also Figs. VII to X.)

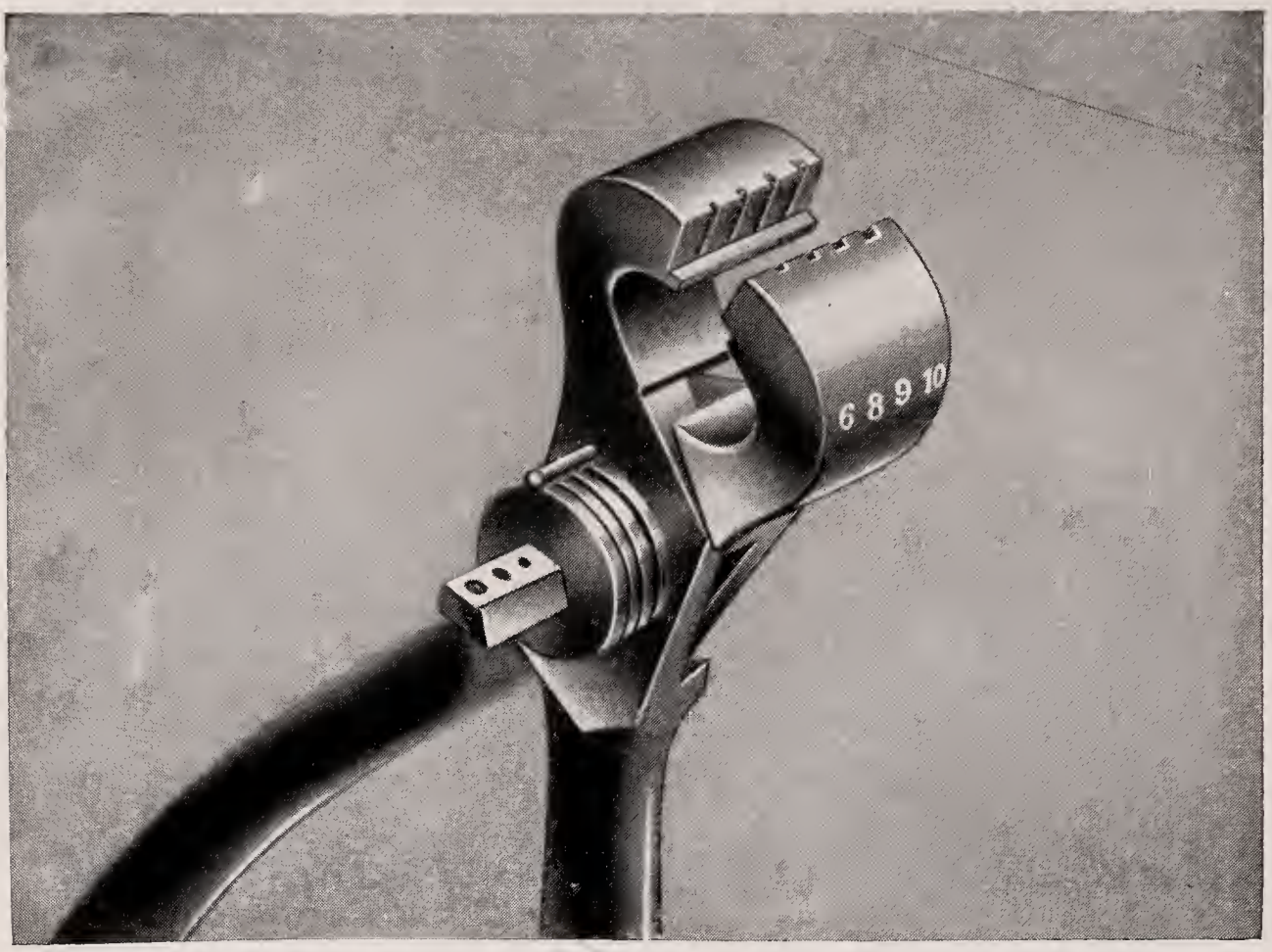


Fig. VII.

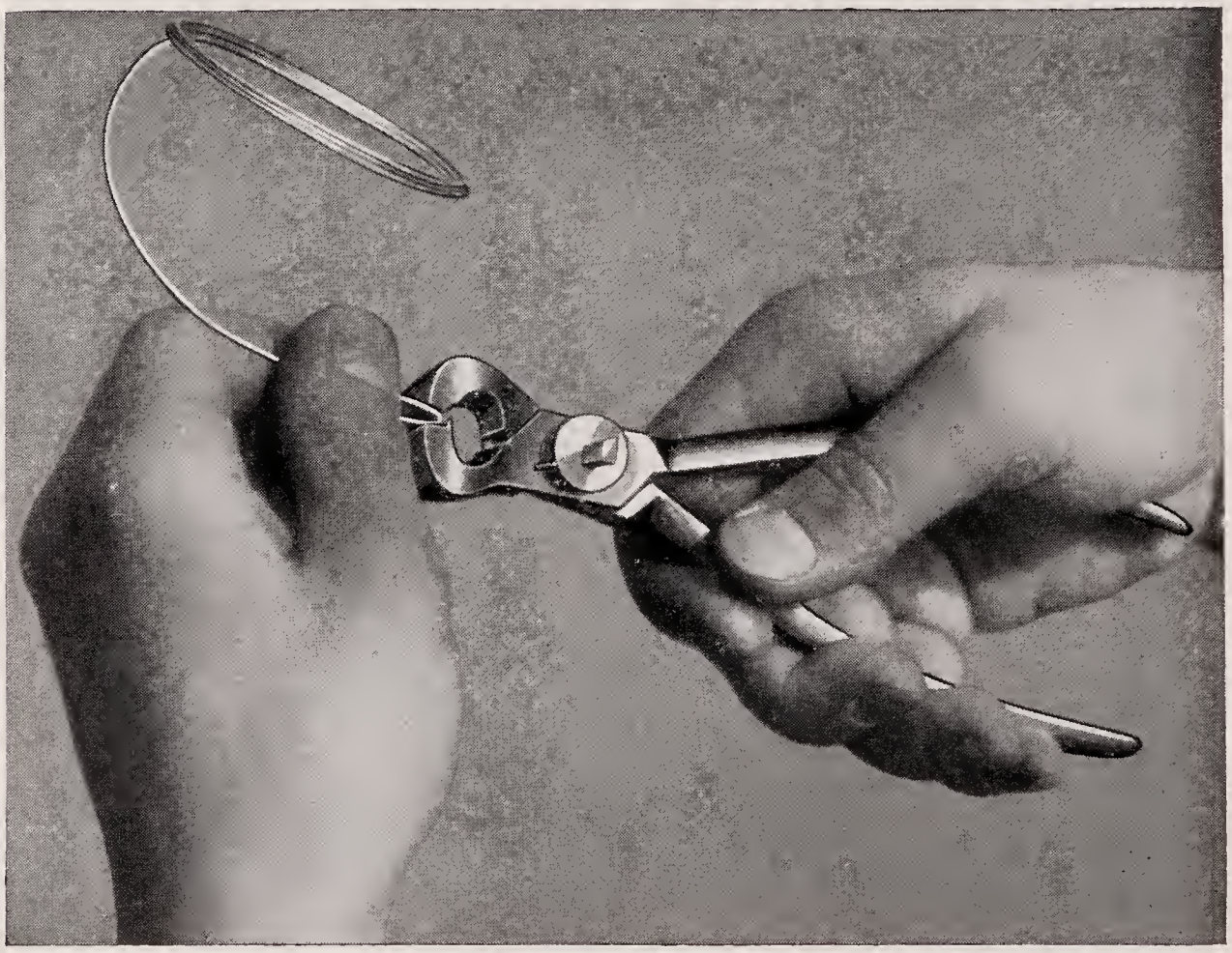


Fig. VIII.

Fig. IX.

Fig. X.

0.7mm. in the second ; 0.6 and 0.5mm. in the third. The left side of the pin is vertical, the right is an inclined plane. The loop is held in the pliers with the left forefinger. With flat pliers the right hand bends the short end of the lingual arch to the left over the pin (Fig. XI). On the right, the lingual arch is bent by hand over the inclined plane (Fig. XII), and then taken out. With the outer side edge of the orthodontic pliers, the short piece which lay on the inclined plane is grasped, and the arch is bent back into the desired position with the hand, *not with the pliers* (Fig. XIII). Too long a lock-loop is cut off with cutting pliers. Now the pressed loop is inserted in the tube on the left of the working-model, and the lingual wire is formed by hand, or in the round groove of the wire-former, to correspond to the arch of the teeth and carried across over the right oval tube. With a file, 4mm. behind the tube a mark is scratched, the arch is taken out and cut off 1.5cm. behind the mark. The left hand again seizes the closed orthodontic pliers, the same as in the pressing of the first loop ; the right hand holds the lingual arch to the right of the pliers. Now the end of the arch, after having been heated (1 second red-hot), is inserted into the fitting hole of the pliers as far as the filed mark, but this time from below (Fig. XIV), completely bent upwards and taken out. Then follows the pressing of the loop, already described. Now the arch is fitted into the tube, and then, as already described with the first lock, formed in the pin of the orthodontic pliers. The ends of the lingual arch are cut off to 4mm.* Now the arch, set into the tubes, has too much tension. In order to give it an easy, passive position, the lingual arch is held with a file or pliers in the desired position on the working-model behind the incisors and is heated with the needle-point flame in front of the loop-locks. And then it will remain in the proper passive position without tension.

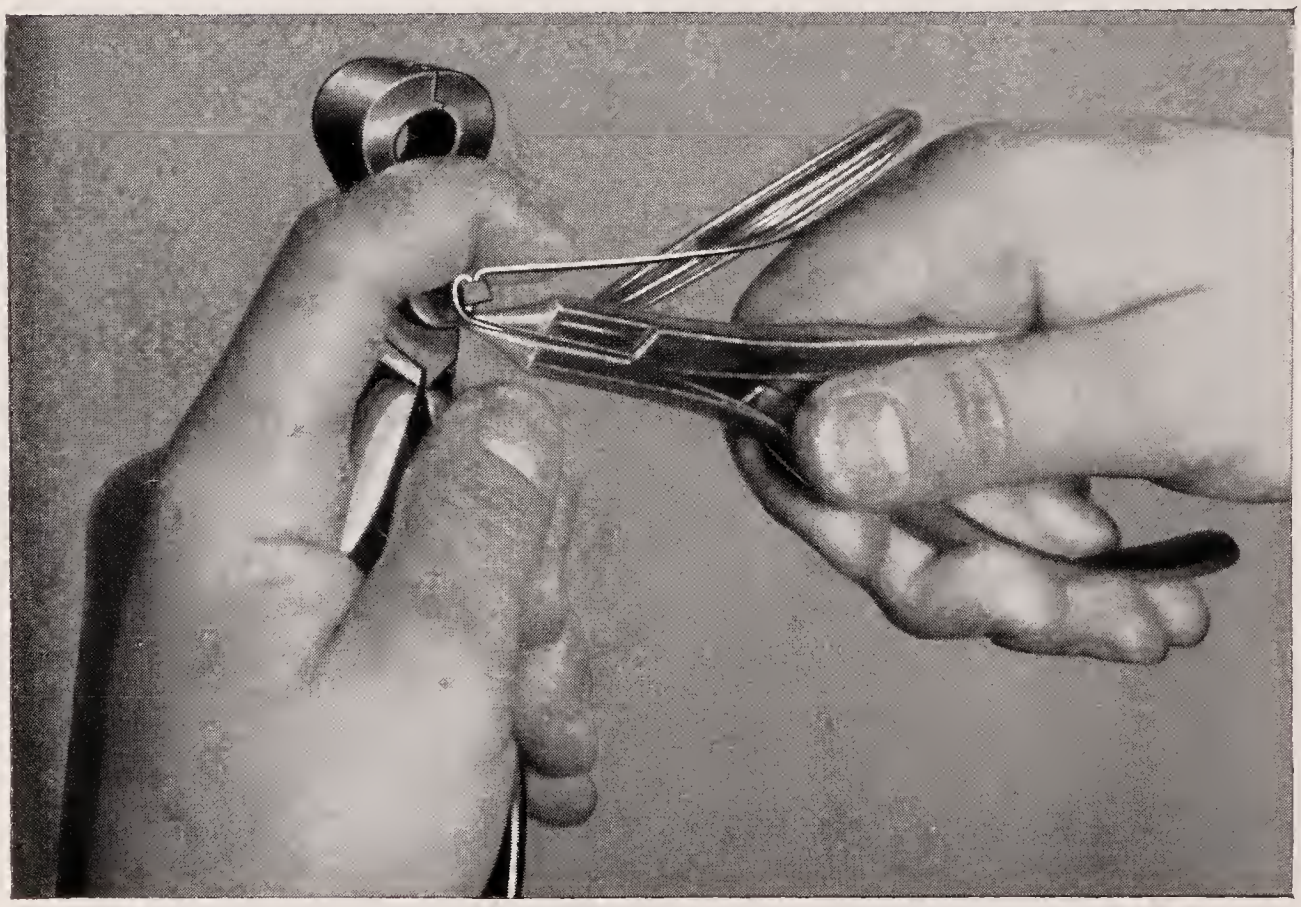


Fig. XI.

* These ends are fixed with a tie-bracket on the bands.

Fig. XII.

Fig. XIII.

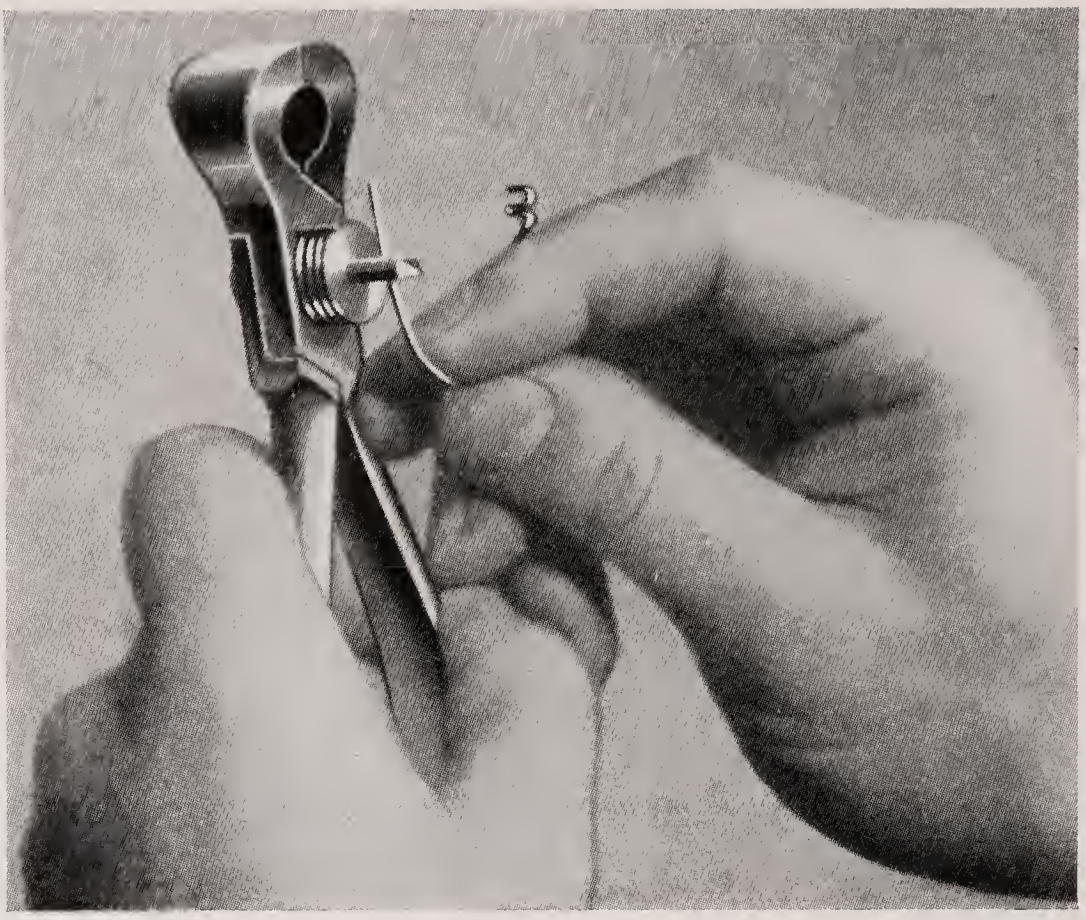


Fig. XIV.

Soldering the Spring-wire to the Lingual Arch.

Let us take as example the most-used recurve spring-wire. The arch is placed in the tubes on the working model, and the point of attachment for the recurve spring-wire, which we usually locate opposite the second half of the first premolar, is marked with the file. The arch is taken out and slightly heated with the flame at the file mark. Brown flux is put on with the spatula under the mark and also on the other side of the arch. Take wire-solder in the right hand, dip in the flux, and set it on the flux already on the arch, direct the flame to this place, and melt sufficient solder. Hold the hands as in Fig. XV. Now take a piece of spring-wire (0.7 or 0.6mm.) warm the end in the flame then dip in the flux and place it on the melted solder on the arch, not quite on the under-curve of the arch, but a little to the side towards the palate. Now bring the solder to the melting point with the flame. Hand position as in Fig. XV. After the soldering, we let the flame sink and wait a few moments for the solder to harden.

Bending the Spring-wire.

We have had exceedingly fine half-round pliers made. These pliers are not used for bending the wire, but *it is bent by hand over the pliers.*

Phase 1. The spring-wire directed towards the palate is held with the half-round pliers on the arch and completely bent outwards.

Phase 2. The fine, half-round pliers follow after a little, and the spring-wire is bent backwards by hand parallel with the arch. In this way a little ring, important for the spring, is formed.

Phase 3. The half-round pliers hold the spring-wire in position before the first molar, and now the wire is bent by hand, parallel with the arch of the teeth, forwards and outwards. The wire is cut off to the desired length and correctly placed with the round pliers.

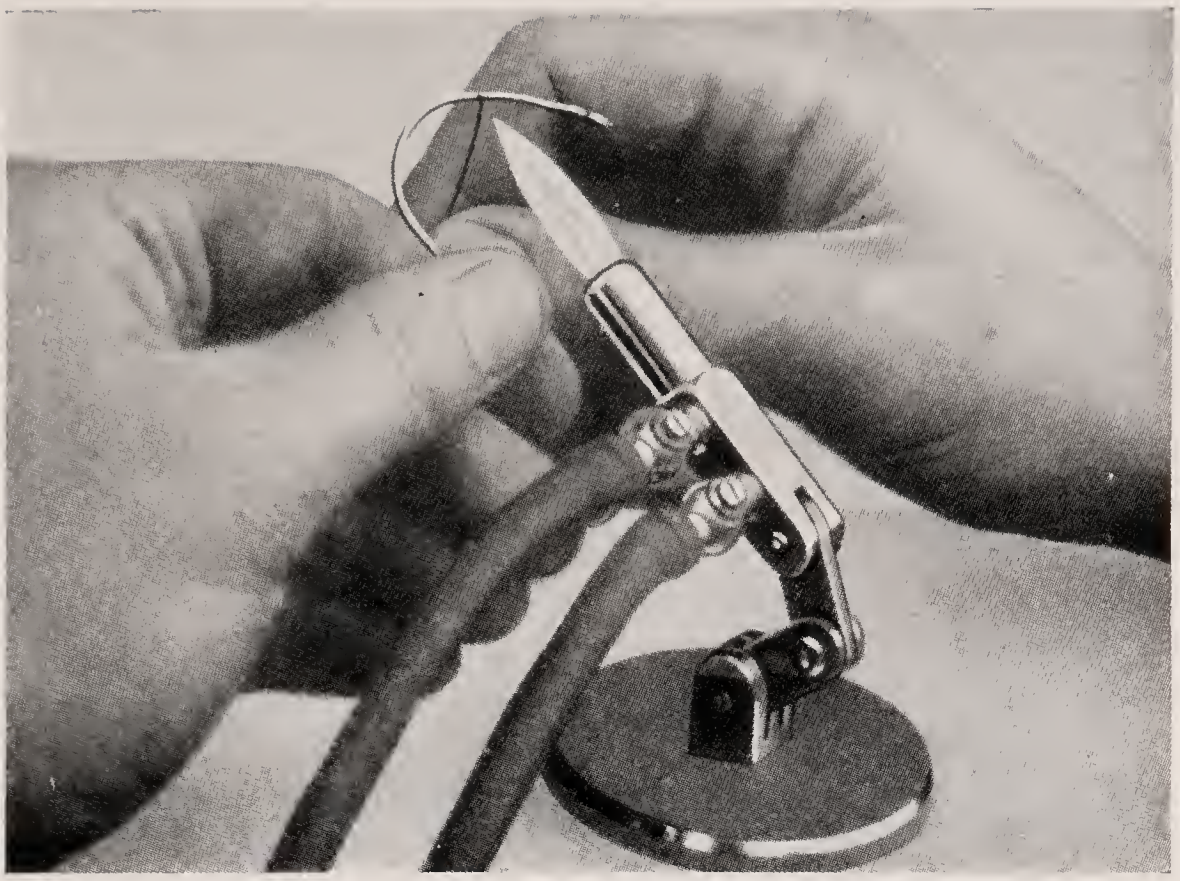


Fig. XV.

THE LABIAL ARCH.

(a) The Round Arch.

For a simple labial arch we can use the round Wipla wire o.8mm. in connection with seamless round tubes, which are soldered on to the molar bands horizontally. It can be used for the treatment of the abnormal positions of single teeth, which by means of soft Wipla ligature wire (0.3mm.) are drawn up to the arch. In the case of a prolongation forwards of the arch of the teeth a loop is bent high in front of the tubes ; but usually it suffices to apply a fine attachment which is fastened to the arch by a pressure of the tie-bracket pliers. This prevents the arch from slipping into the tubes.

(b) The Horizontal Band or Edgewise Arch.

I prefer as a labial arch the horizontal edgewise arch. Wipla metal is much better suited for this arch than any gold alloy. The arch is constructed rectangular (0.6 by 0.5mm.) and it is exceedingly delicate and flexible. It is used almost without exception in connection with incisor bands, whereby an absolute stability of the arch is attained.

MOLAR BANDS.

The construction and soldering of molar bands has already been described. The work on the patient is the same as that for the lingual arch.

INCISOR BANDS.

We take a roll of polished Wipla band-material of 0.1mm. and with the bandform-pliers make at the end a right-angled bend of 3mm., form the band by hand in the shape of a first incisor and slip it over the incisor in the patient's mouth. While the left hand holds the band firmly, the bandform-pliers in the right hand make a sharp fold towards the tongue.

SOLDERING AN INCISOR BAND.

We do not lay a double fold as with the molar band, but both ends are cut off to the length of 1mm. Mark distinctly between the orthodontic pliers and press with an instrument.

In order to procure a close joining of the ends, these are overlapped several times. Flux material is applied to the groove and then soldered, as has already been described. The incisor bands —there will be, according to the case, two or sometimes four—are placed in the mouth again and thoroughly polished. Any surplus is worked towards the distal edge of the tooth, folded with the fine pliers and later on soldered. The incisor and molar bands being adjusted in the mouth, an impression is taken and the working-model completed.

Soldering the Open Rectangular Tube and the Tie-Brackets to the Incisor Band.

(a) The Open Rectangular Tube.

For the fixing of the edgewise arch the open rectangular tube is used. By this means a bodily movement of the teeth is made possible, which is necessary in the case of a bad axis position of the front teeth. We choose one of the fine open rectangular tubes. The point where the tube is to be soldered on to the labial surface of the band, is marked with a file. The incisor band is taken from the working-model and the plaster parts are removed with a metal

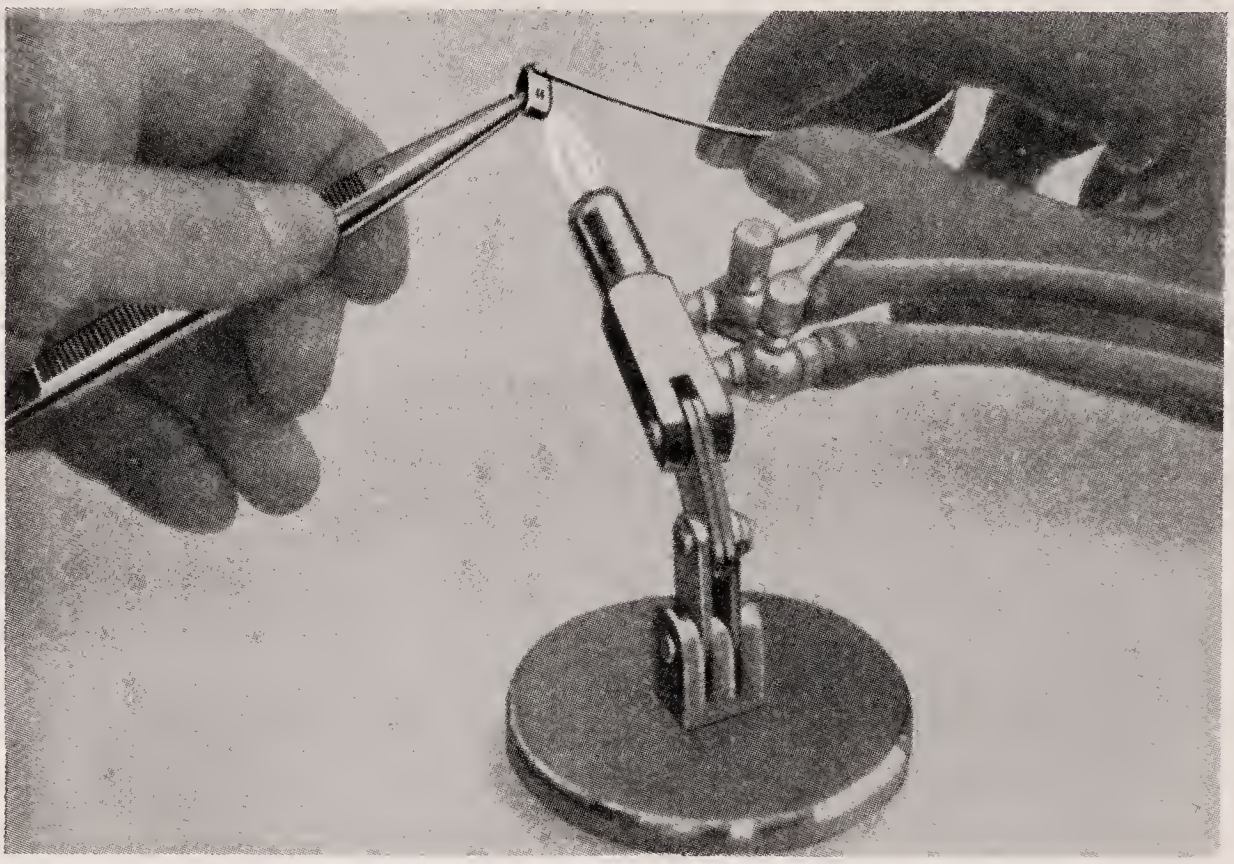


Fig. XVI.

brush. Now the band is warmed in the flame, and the flux and solder are applied to the marked place. With the fine bent pliers we grasp the open rectangular tube and solder it on the middle of the band, mesial or distal, vertically to the long axis of the tooth ; mesial if the front tooth is turned distalwards, distal if it is turned mesialwards, i.e. mesial or distal torsiversion.

(b) The Tie-bracket and the Tie-bracket Pliers.

We take a longish piece of rectangular wire, heat the end, and push it into the tie-bracket pliers, which are used for pressing this fine, but very secure ligature wire holder. A pressure of the pliers, and the tie-bracket is stamped. In the right hand we hold the tie-bracket by the long wire, with the help of which the soldering

is very easily accomplished ; we warm the bracket in the flame and then apply flux to the lowest point of the bend. The ligature wire holder must be soldered on beside the open rectangular tube in the second half of the labial surface of the incisor. This point is again marked. Flux and solder are applied to it and the prepared bracket is soldered with the finest needle-point flame (Fig. XVI). The wire is cut off to 3mm. Both tips of the tie must not be longer and must be inclined towards the band, so that they do not interfere with the lips. Sharp edges must be rounded off by filing. If no torsion of the tooth must be performed and there is no faulty axis position, the tie-bracket with the wire ligature suffices for the support of the edgewise arch. The details of both attachments are plainly shown on Fig. XVII.

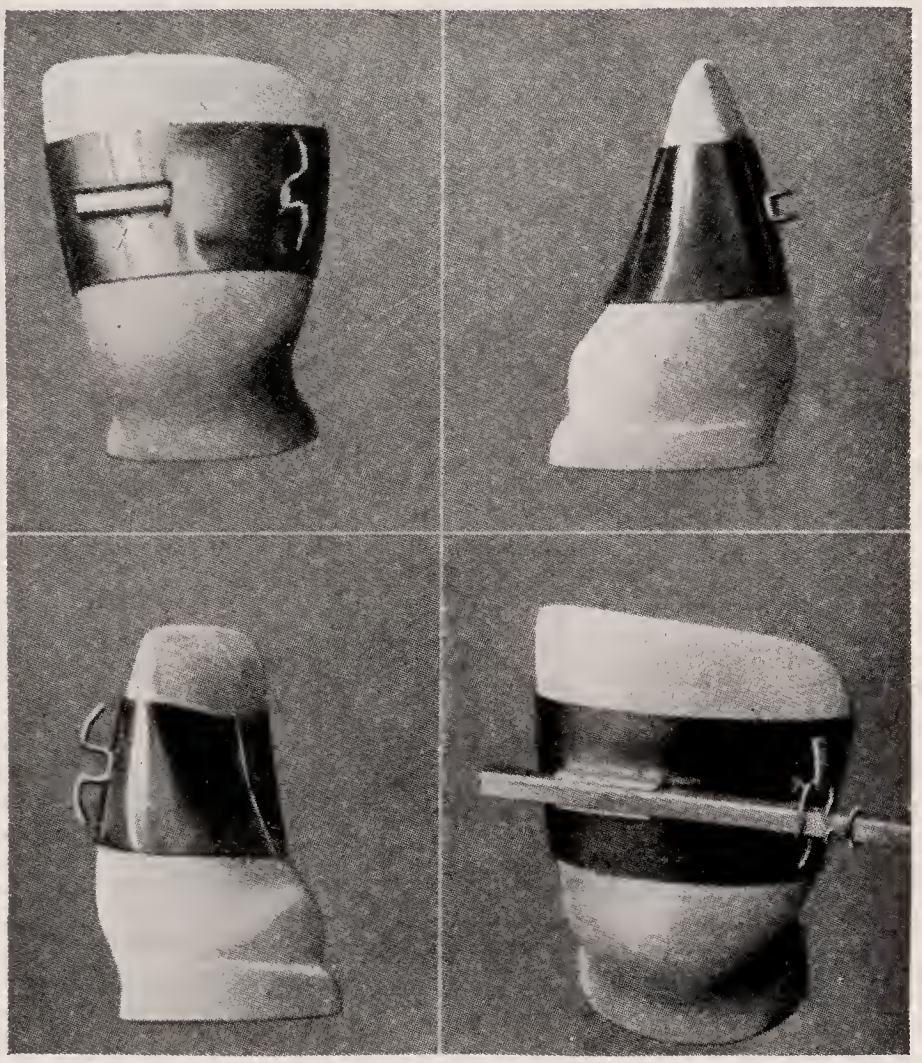


Fig. XVII.

Soldering the Seamless Rectangular Tubes on the Molar Band.

The exact determining of the position of the tube is very important. We take a file and hold it on the working-model so that it touches the middle of the buccal surface of the band and gauge to the middle of the incisor crown. The position of the tube is marked with the file according to this line.

The tube is rectangular and must be soldered on the narrow side, so that a third of it projects free backwards. This free end serves for the support of a wire ligature. The tube can be soldered on by hand : the placing in the indicated direction is, however, somewhat difficult. It is therefore preferable to solder the tube on the working-model in the following manner : take a finished arch, place it in the rectangular tube and hold it on the bands in the desired position.

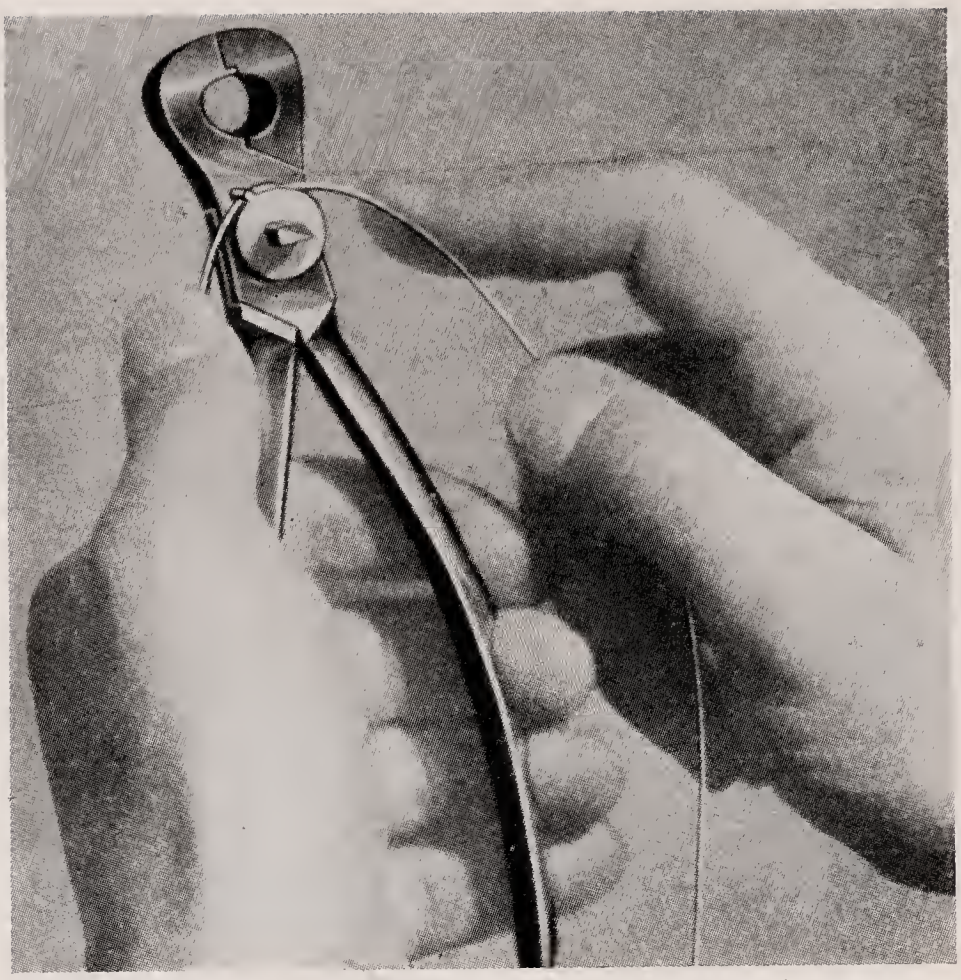


Fig. XVIII.

We first solder one tube to the band and then the other. In this way the direction of the tubes and the arch exactly agree, and the latter lies in the correct horizontal plane, that is, with the greater diameter of 0.6mm. With an inclined axis position of the front teeth, the open rectangular tube does not at first lie in the same

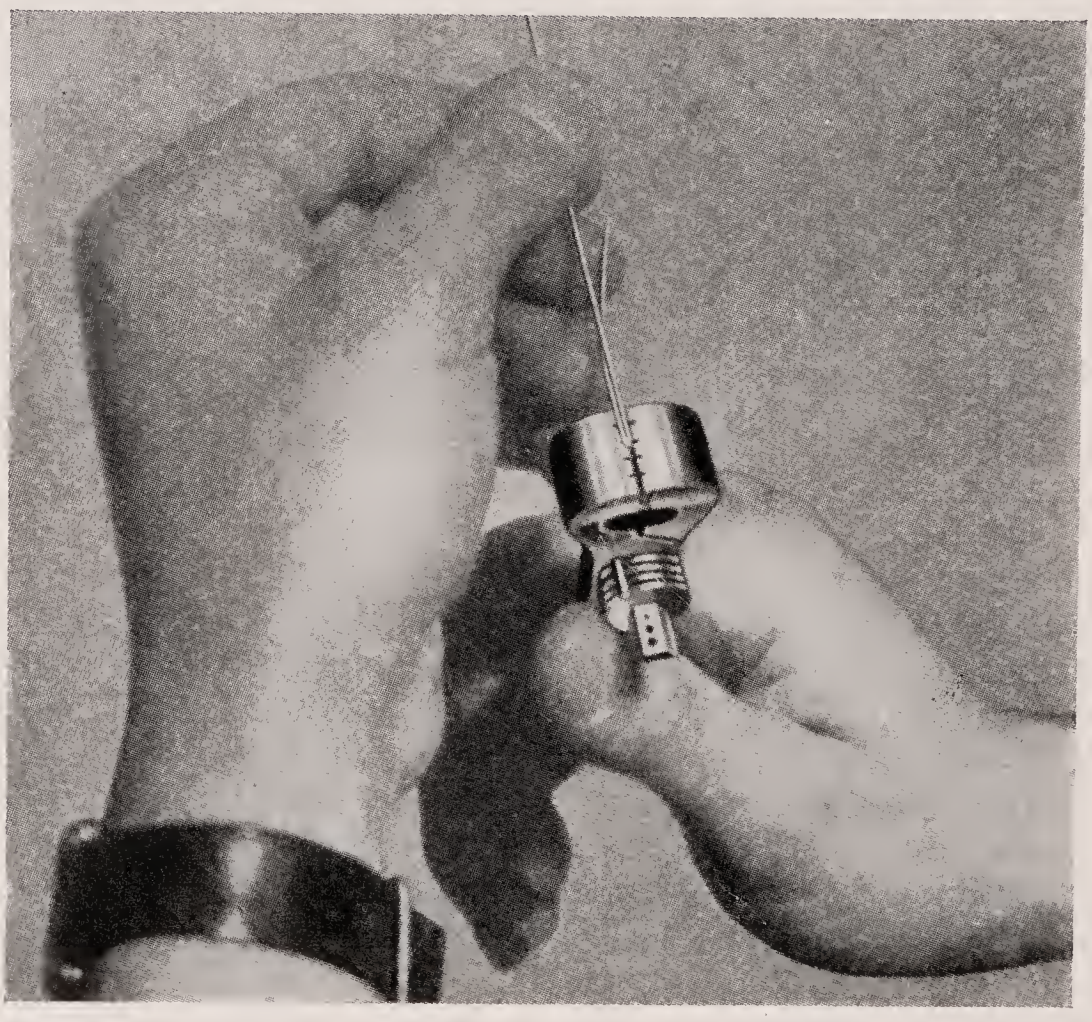


Fig. XIX.

plane with the arch. The exceedingly flexible arch can nevertheless be inserted in the open rectangular tube of the incisor bands, with which the teeth are brought to an erect position. The inserted arch is used only for soldering, as it has become, through the intense heating, too soft to be used in the mouth.

Bending the Rectangular Arch.

In order to give the rectangular arch the correct form, we bend it in the wire former of the orthodontic pliers. The former has three grooves. The upper one is for the 0.5mm. rectangular wire ; the second for the 0.6mm. wire ; the third for round wire of 1mm. and less. The rectangular wire of the larger diameter (0.6mm.), is pushed through under the bending pin of the wire former, slightly bent, pushed farther along, and bent again, until the desired form is obtained. (Fig. XVIII). The arch is fitted into a tube, once again shaped to the arch of the teeth, and then cut off behind the second tube, leaving an end of 2mm. at the most. If the case is one of a reciprocal moving of the front teeth (for example, the first incisors being in labial occlusion, the second incisors in lingual occlusion), we can make use of this simple, smooth arch. For drawing back the front teeth, in a case of neutroclusion or distoclusion, we use an arch with a hook for supporting the wire and elastic ligatures. This arch with the hooks can be procured ready-made, or we can ourselves, with the help of the orthodontic and half-round pliers, bend a double loop without soldering anything on the arch.

Construction of the Hook on the Arch.

We form the arch in the wire former of the orthodontic pliers (Fig. XVIII), and leave both the ends 2cm. longer than on the smooth arch. Now the points are marked where the hooks are to come, namely near the canine teeth. We make a second mark 5 to 7mm. behind the first one. Only these second marks are heated with the soldering lamp.

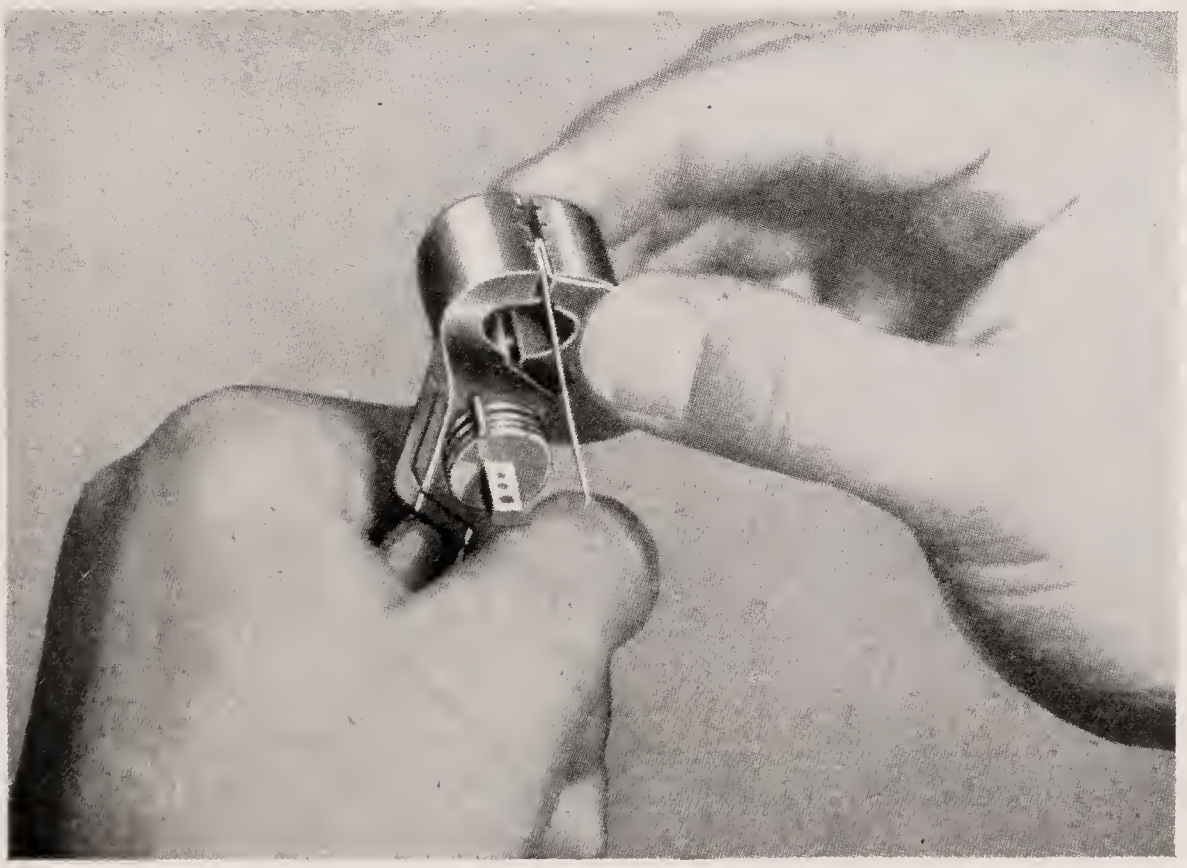


Fig. XX.

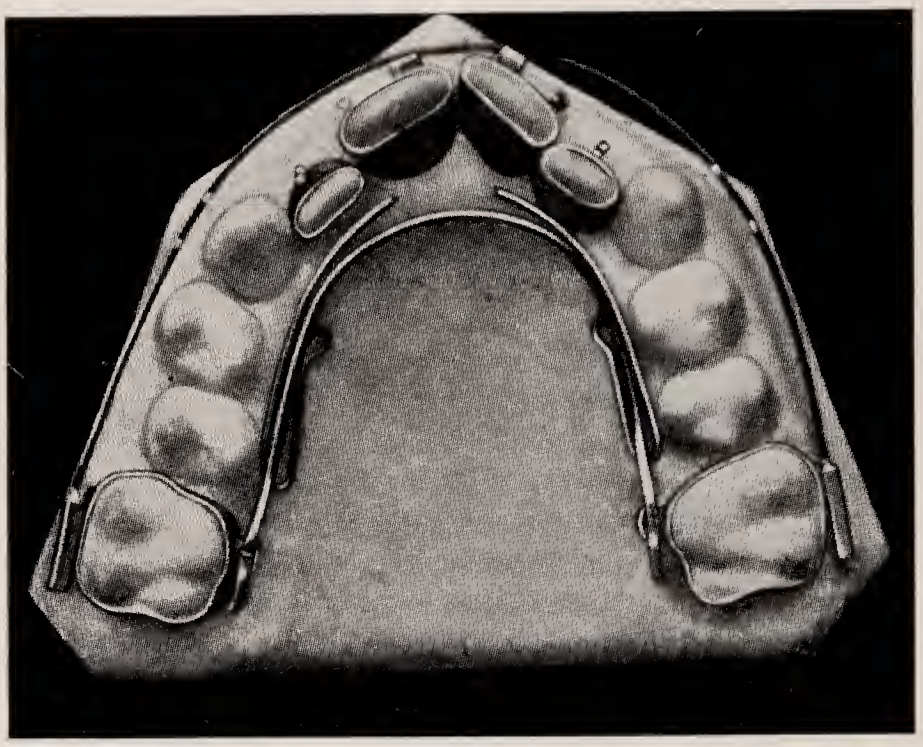


Fig. XXI.

This bent hook is very practical for the support of wire and elastic ligatures ; it cannot tear off, especially if we put some wire solder in the loops.

Construction of an Arrest.

If the arch is not to slip back into the tube of the molar bands, we construct an arrest with the tie-bracket pliers. In front of the tube the arch is marked with the file, and this point is slightly heated. Just in front of the heated mark, the rectangular arch is grasped with the tie-bracket pliers and pressed in. If we are obliged to alter the position of the arch in the course of treatment, the little bend is again heated, the rectangular wire straightened in the orthodontic pliers, and a new arrest constructed.

Combined Use of Labial and Lingual Arches.

In many cases it is advisable, at the beginning, to solder a lingual and a labial tube to the molar band. It will often be an advantage, even a necessity, to begin simultaneously with both arches. Fig. XXI shows the two arches. If we begin our treatment with the labial arch alone, the lingual arch must be constructed on the working-model without spring wires. It will later, at least, render us excellent service for the retention of the corrected tooth position. In a case of protruding upper jaw, the first premolars have been extracted. With two fine finger wires on the lingual arch the canine teeth are drawn back, while the outer arch presses in the front teeth.

Pickling and Polishing the Soldered Appliances.

After the soldering, the single pieces are laid in diluted nitric acid from 10 to 15 minutes, until the scale disappears. Take care ! Too long pickling dissolves the solder entirely. All sharp edges and folds are once more treated with a little whetstone, and then are polished either with felt, brush and pumice, or with the brown Krupp polishing paste, until all the dark places are bright. The best high polish is obtained with the green high-polish paste which has been specially made for this purpose.

Discussion.

Dr. Friel said he had listened with great interest to Dr. Schwarz's paper. It was very difficult to discuss a paper of a practical nature such as his, because one really wanted to go and make the appliances dealt with and then come and tell the author of the paper how good or how bad they were. He was very pleased to hear that Dr. Schwarz used a thick arch of 1mm., because he thought the arch should be sufficiently strong to resist any effect of the springs in contracting or expanding it. When arches of .7 or .8mm. were employed, the spring actually deformed the arch and there must be a certain amount of pressure causing a to and fro movement of the anchor teeth, which movement must be very detrimental. He would like to ask Dr. Schwarz what was the diameter of the spring wire that he used ?

Dr. Schwarz : .6mm.

Dr. Friel, continuing, said he was surprised that Dr. Schwarz used such strong springs. Perhaps he personally had been unfortunate, but he had had rather a bad accident when using a short spring of only .4mm. wire ; an acute abscess had developed on a lateral incisor, and the lateral incisor had had to be extracted. It is possible that the pressure of the spring had nothing to do with the formation of the abscess. He now was using spring wire of .25, .3mm. and .35mm. diameter, which was very much thinner than that used by Dr. Schwarz, and he thought he was getting the movement just as fast as he had obtained it with the thicker wires. There was one other point he wished to mention that was of importance in the formation of springs, namely, that the spring should work only in the direction in which one wanted to move the teeth. Dr. Schwarz's spring for lateral expansion swings laterally from its point of attachment, any portion of it moving along an arc of a circle, so that the resultant of the forces acting on any of the teeth in contact with the spring, was not directly outward but outwards and backwards. This outwards and backwards direction of the force caused the teeth that were being moved to jar on each other. He would have preferred the spring to be double, i.e. the spring to be attached to the arch in the region of the canine, then to extend backwards as far as the most distal tooth to be moved and then bent so as to return to the most medial tooth to be moved. This returned portion to be in contact with the teeth. A concertina action rather than a swinging action was obtained. It seemed to him that Dr. Schwarz's spring for moving back the canines was too powerful and that there was not sufficient range of movement. With regard to the question of welding versus soldering, personally he had never soldered stainless steel. There was no doubt that welding was very easy and there was no cleaning up to be done afterwards. He could not find any fault at all in welding. He thanked Dr. Schwarz for his very interesting paper.

Dr. George Northcroft said he was sure everyone present had listened to the paper with great interest and would join with him in thanking Dr. Schwarz very sincerely for coming to this country to demonstrate his methods. He would like to know whether the flux which Dr. Schwarz used was potassium fluoride and what was the nature of the solder that he employed. He had used potassium fluoride as a flux, together with a silver solder called " Turbine " ; he preferred spot welding. He thought Dr. Schwarz had shown great ingenuity in the bending of some of the springs and that the very ingenious pliers he had shown were worth acquiring.

Mr. H. G. Watkin said he wished to join the previous speakers in expressing his thanks for and appreciation of all the work that Dr. Schwarz had shown that evening and also the trouble he had taken

in making the slides, which he knew entailed a great deal of labour. He was very much interested in the soldering carried out by Dr. Schwarz. He had tried soldering but had now abandoned it in favour of welding, which did the work equally well. He was glad to hear that Dr. Schwarz had been successful in making the joints secure. Some time ago he himself did a good deal of soldering with stainless steel. He always tried not to overheat the wire. He found that in quite a number of cases, say in making a " T " joint, when it had been in the mouth about a month it could be twisted round like a hinge on a door, although a good solid joint had apparently been made. With regard to polishing, he found a Burlew disc the most suitable thing to use for that purpose. He believed that Dr. Schwarz mentioned a stone, and that might be quite good, but the disc removed the stains after welding without scratching and left the surface like polished silver. He agreed with Dr. Friel about the size of the springs. He found that wire of a diameter of .4mm. was too strong for certain cases and he had recently ordered wire of .3mm. for finger springs. With regard to the actual soldering process, Dr. Schwarz seemed to be very accomplished in being able to put on the right amount of solder. Personally he had found a simple way of getting the right amount of solder. He used a tiny flame about 3mm. long and what he might call a soldering iron, a piece of stainless steel wire. He warmed it and dipped it in the flux and then held it in the flame and melted a small blob of solder on the end of the wire. In order to join two wires together he put some more flux on the soldering iron, with the solder on it, put that in the flame and then brought the other wires up to it but not in the flame. This avoided risk of overheating the wires to be soldered. He would like to know where Dr. Schwarz obtained his models, as he thought they were very good. He was very pleased to hear that Dr. Schwarz used heat-treatment in adapting 1mm. lingual wire. Personally he had not tried that yet ; he had always thought that it would make the wire too soft to be any good afterwards, but apparently it did not do so. In adapting the wire to a central incisor, he understood that Dr. Schwarz pinched in several places and then soldered at the pinches. If the band material was cut not straight, but like the roof of a house and the longer side was put towards the gingiva, it came straight round the tooth. The band material was obtained 2mm. or 3mm. wider than was required ; he had used a width of about 7mm. The result was a zig-zag effect, and a very good fit was obtained with less soldering. This was only necessary when the band was pinched on the labial surface and the seam used for attachments.

Dr. Cale Matthews said it had been a great pleasure to him to listen to the very lucid way in which Dr. Schwarz had presented his thesis. As one who had seen a great deal of Dr. Schwarz's work in Switzerland, he knew how extraordinarily thorough and scientific he was in all his methods of calculation. Many people who employed steel seemed to find its technique extraordinarily easy, but to him it was difficult. Certain of the difficulties that he found, however, had been somewhat lessened by seeing some of the material shown by Dr. Schwarz that evening, which was apparently, an easier working material than that which was generally used in this country. The incisor teeth band metal that Dr. Schwarz used, for example, seemed definitely more adaptable than anything he himself had been able to obtain here. With regard to the formation of incisor teeth bands, he had never found any difficulty in the adaptation of them to cover the teeth. Where one wished to cover a central incisor tooth with a band as high as the gingival margin, if the metal was held in the pliers

with an upward tendency and well pinched, the straight metal would travel perfectly and adapt itself beautifully without any of the contouring described by Mr. Watkin. It was simply a question of having the metal sufficiently malleable and bringing the pliers up to the highest point to cover the upper portion of the tooth. He learned that first from Dr. Francis Jackson of Philadelphia some time ago, and he had always found it a very simple technique to adopt. An interesting point was the adaptability of the Steel's facing pliers in making the various little open and closed tubes, which were made very simply to fit any gauge of wire. He desired to join with the previous speakers in thanking Dr. Schwarz for his paper.

Mr. NORMAN GRAY said he wished to thank Dr. Schwarz for a most instructive evening; he thought it had been well worth his while to come to London from Eastbourne in order to hear the paper that had been read. He had only recently started to use stainless steel and had found a number of "snags" in its use. It was interesting to him to hear what Dr. Schwarz had said about some of these. One point that struck him particularly was the use of the special pliers. It seemed that the loops and angle bends could be standardised every single time with the type of pliers that had been shown that evening, and he thought the pliers were a very great help in standardising the locking attachments for the anchor bands. Personally he had not been able to make steel wire passive again by heat treatment. He did not know whether that could be done with English wire. If it could be done with the Wipla wire he thought it would be much more satisfactory to use that than the English wire. He wished to thank Mme. Schwarz for reading the paper and Dr. Schwarz for the splendid slides that had been shown to illustrate the reading.

Dr. SCHWARZ, in replying to the discussion, said he was not afraid to use a wire with a diameter of 6.10mm. or 7.10mm. He liked a simple spring wire, and he preferred to solder it. At the same time he also used thin springs. One should not go too far in the complicated construction of a spring, because the mouth is no watch-case which is protected by a cover. He had never been able to see one single root-resorption in all his cases treated with stronger springs. The biological result of the spring depended on the hand by which it was bent. As flux the brown paste from Krupp proved to be the best, as solder the very thin wire-solder of the same firm. The new orthodontic pliers were the speaker's own invention and were obtainable at Messrs. E. & H. Renfert, dipl. jng. 10, Huyssen-Allee, Essen—Ruhr, as well as the booklet "Regulating Appliances of Wipla Metal" in the English translation. The speaker's method proved that the soldering of stainless steel was very easy indeed and did not affect the material. It was especially important for those who wanted to save the expense of a welding apparatus.

THE TREATMENT OF DAMAGED INCISORS IN CLASS II, DIVISION I, CASES.

By B. Maxwell Stephens, L.D.S.,R.C.S.Eng.

In the *International Orthodontic Journal*, 1933, is published a questionnaire entitled "Fractured and Lost Anterior Teeth." Circulated by the Detroit Clinic Club, it deals with treatment very thoroughly, and, as stated in the Summary, it contains a wealth of valuable information. It is composed as follows:—What is your method of treatment and restoration in the following cases?

1. Child, aged 8 years, maxillary central incisor lateral fracture with incisal half lost, with desensitised pulp protruding from the tooth.
2. Child, aged 8 years, maxillary central incisor lateral fracture with incisal half lost, with pink showing through the dentine.
3. Child, aged 8 years: (*a*) a maxillary central incisor lost; (*b*) two maxillary central incisors lost.

The questionnaire invites no mention of the closure of the spaces by treatment or otherwise, but I find one allusion to the fact that the spaces will close up sometimes or can be caused to close up in favourable cases. A correspondent incidentally remarks that he has seen many cases where the space created by the loss of incisors has been closed up by the remaining teeth.

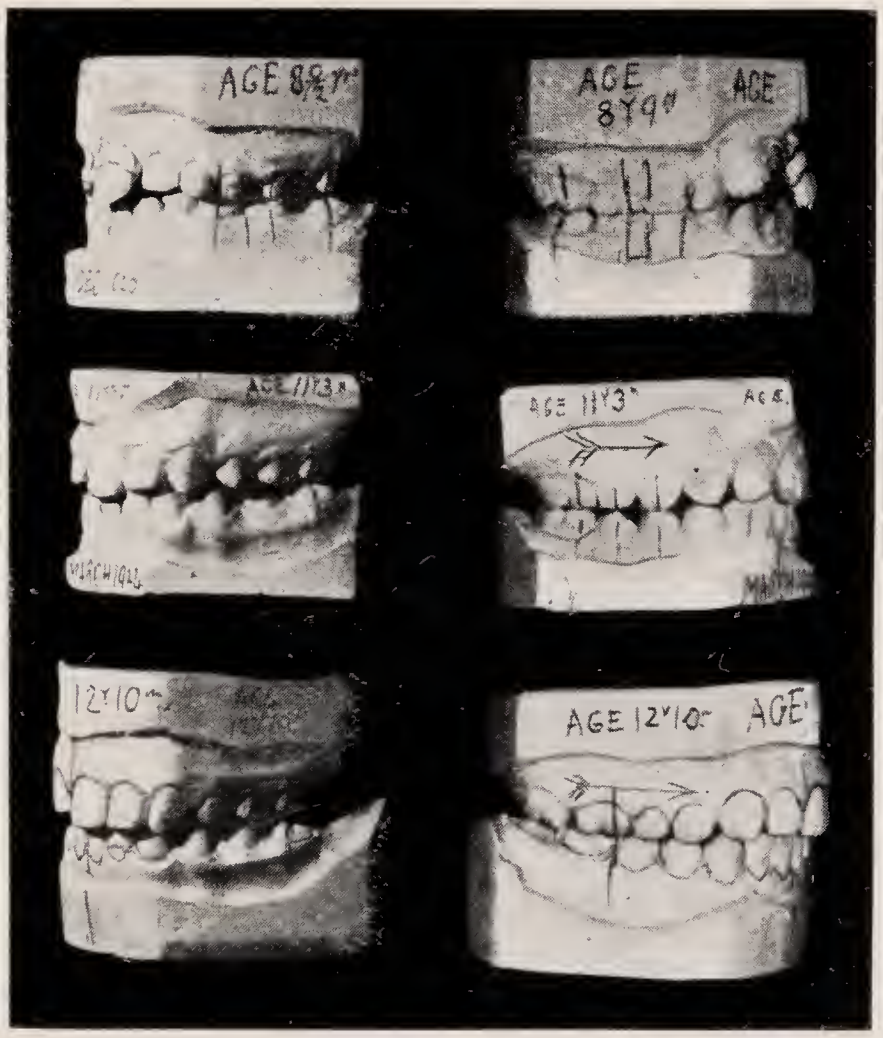
To treat the subject completely would necessitate a long paper; the consideration of the loss from the deciduous, transitional and permanent dentition, and the adolescent stage, would spread itself over too wide an area to be covered in a short communication.

The general practitioner, who is more frequently in contact with the result of focal sepsis, would, we know, approach the subject from a different point of view from the orthodontic purist; hence the difficulty which he will sometimes experience in these cases in accepting the recommendation of the specialist, however ideal. It is a platitude to observe that the orthodontist who has had general experience is best qualified to advise. Conversely, the general practitioner who has taken the trouble to acquaint himself with the views and skilled work of an efficient orthodontist will realise his own deficiencies better when called upon to decide on the best course of treatment in such cases.

In Britain, called "the land of compromise," we have this Society where extreme views in either direction, that of conservatism or extraction, are freely expressed. Here we tend to act as a clearing house between different schools of thought and technique in treatment. In order to aid those children, who from various circumstances, pecuniary or otherwise, cannot come within the circle of true orthodontic treatment, we have at times to adopt a course in which, while partly surrendering the æsthetic and occlusal ideal, we evolve a line of practical treatment.

From time to time cases are brought forward which in turn show either the dangers or the advantages of extraction. In this room last June, Mr. Bocquet Bull showed a case where a girl, after losing two central incisors, was instructed by her mother to

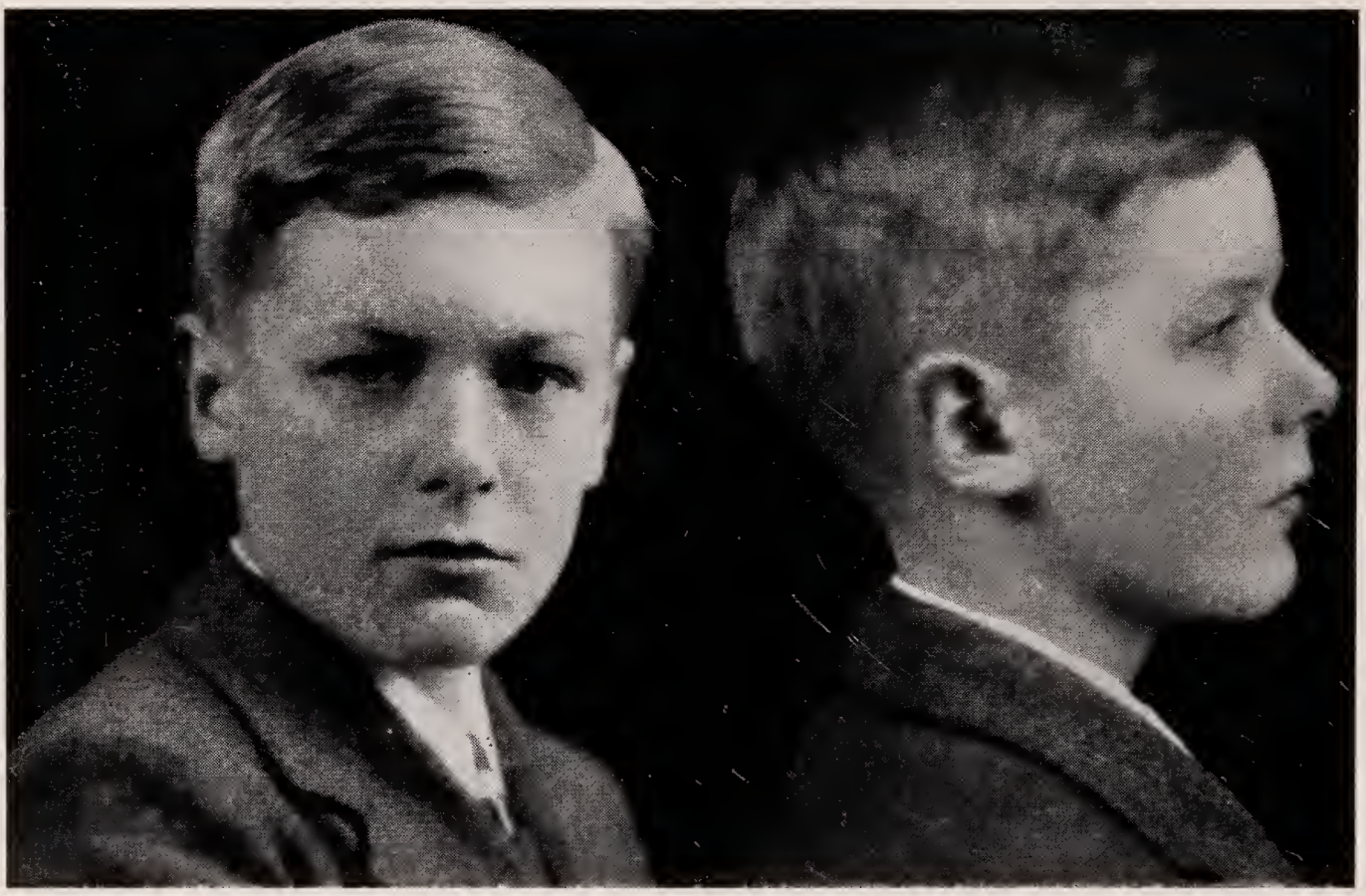
Case I.



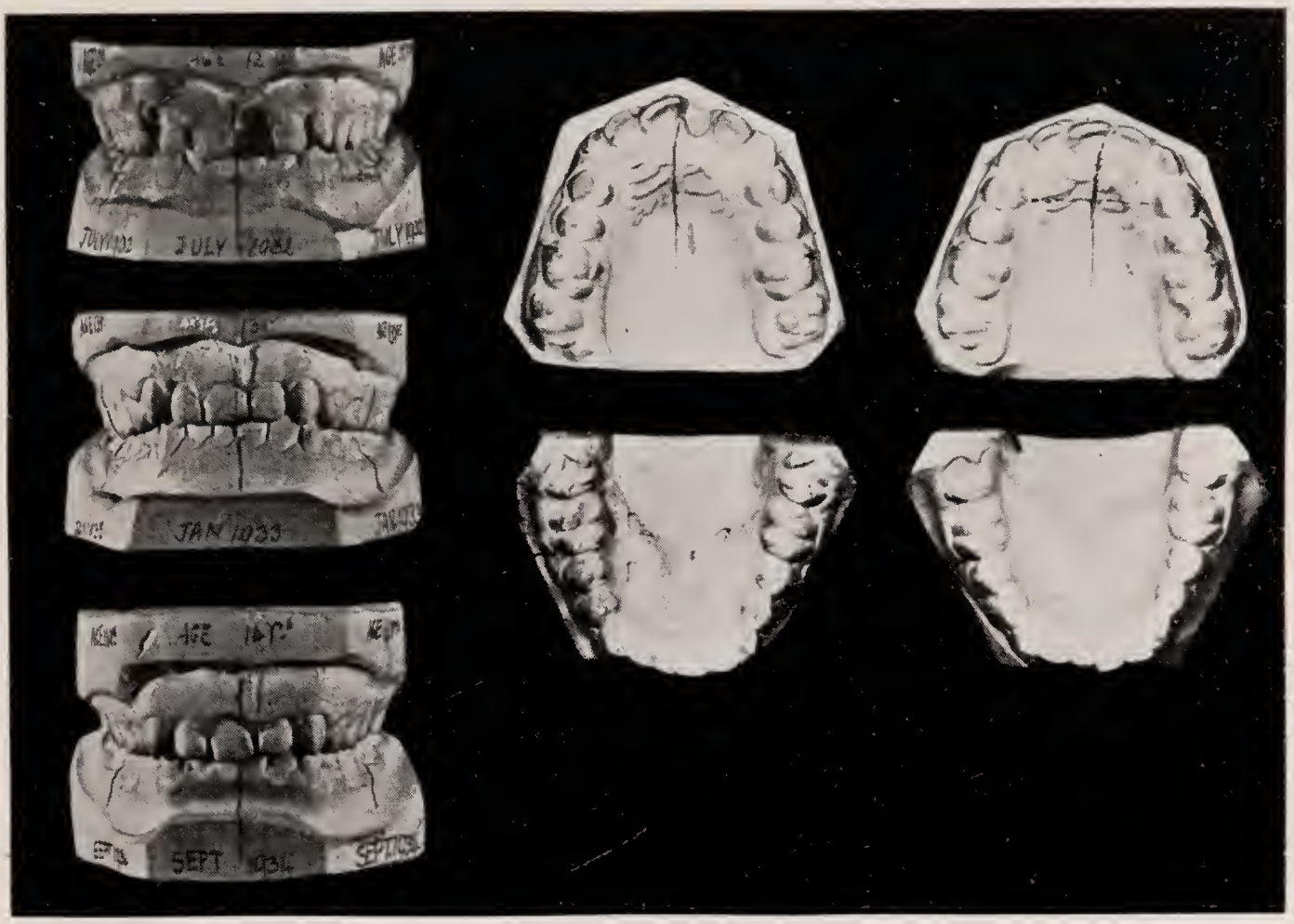
Case I.

Illustrating Mr. MAXWELL STEPHENS' Communication.

Case I.



Case II.



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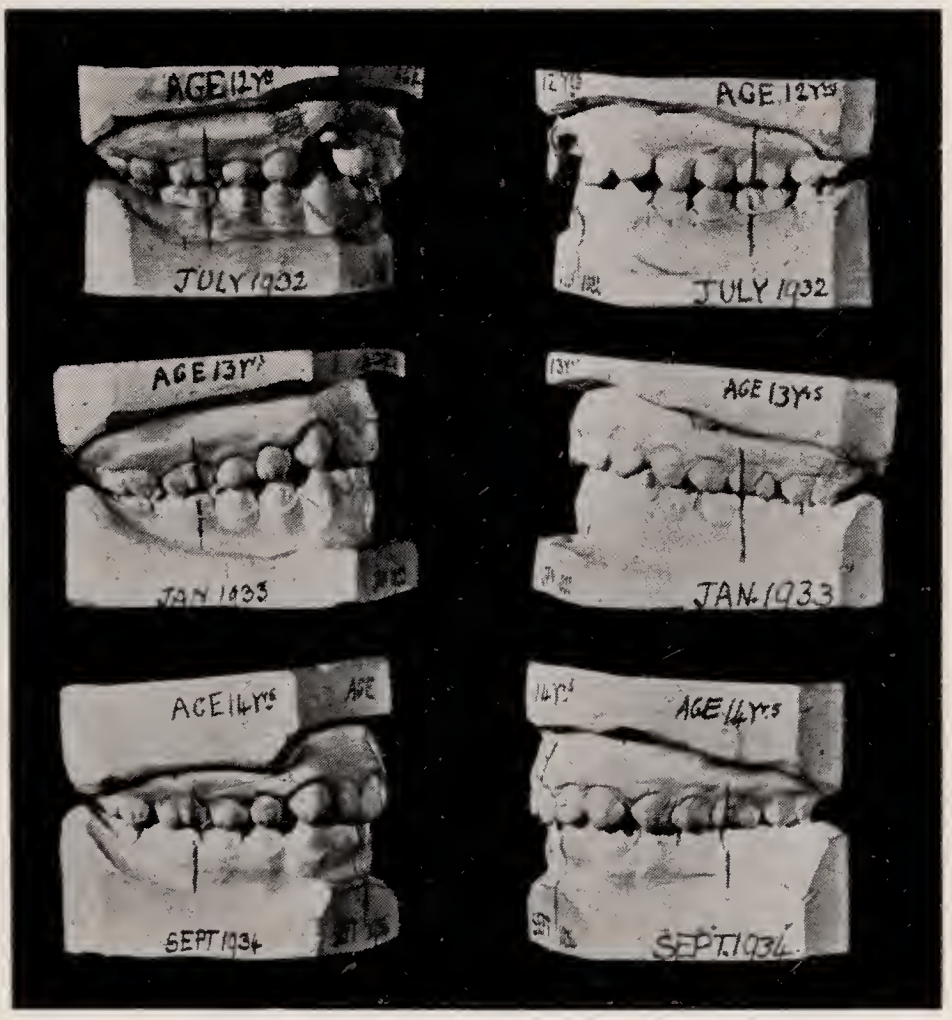


Case II.

Case III.

Case III.

press on the remaining incisors to bring them together, and as a result they closed up. Another member at the same meeting pointed out that a patient of his, as a lad, had lost two incisors, but at twenty years of age he still had an unsightly gap the width of one incisor. During a paper by Mr. Lewin Payne, in which he brought forward a case of suppressed incisor teeth, Mr. Cutler asked a pertinent question as to whether in the case of the absence of two upper lateral incisors, the lower arch should be reduced by the extraction of a pair of teeth to keep the arches in balance. These and other incidents led to my selecting the three cases which I now show.

At the conclusion of his remarks, Mr. Stephens showed slides of three cases.

The first slide showed a photograph of the original model of a child aged 8½ years, taken in 1920. The occlusion seemed to be normal, but if the models were turned so as to show the lingual view, a small amount of tilting could be detected. The second photograph was taken in 1924. The space was closed in about ten months. There had been a gradual drift forward of the upper right molar; this could be seen in the third photograph. The laterals in this case happened to be very big and square, which had been a helpful factor in deciding the treatment. The patient was now about 23 years of age; no relapse had occurred, the case remaining very satisfactory. A photograph of the profile, taken within the last eight months, showed a weak chin, but that did not affect the patient's character, for she possessed a very strong one. In the full face photograph it was not difficult to observe asymmetry, but he did not think it would be noticed unless the face was in repose, which owing to the temperament of the individual was not usual.

The second case (Angle's Class II, Division 1) was that of a boy of 12 or 13. In consultation with his partner, Mr. Buckley Sharp, he decided to remove the left upper central incisor from which the pulp was protruding. It was not such an ideal case for the treatment as the first, but the appearance was satisfactory. The time taken in the closure, nine months, did not affect the case very much; it was not advisable to hasten over it. The boy had a very short upper lip, which was usual in such cases. If one considered other forms of conservative treatment, a rather large exposure of teeth might be shown when the child smiled. When the size of the arch had been reduced anteriorly, it was not nearly so startling. A full face photograph of this case showed that slight separation of the incisors had occurred, but not sufficient to interfere with the boy's facial appearance, even when he smiled.

The third case shown by Mr. Stephens was one of his partner's (Mr. Grayson), and was now under treatment. There had been a loss of two central incisors. He understood that the case was progressing satisfactorily both in facial appearance and occlusion. Shortly after the loss of the two central incisors, it was found advisable to reduce the extent of the lower arch, and remove the right lower lateral incisor. He himself had not seen the boy, so he could not say what effect the treatment would have in the

end, but he would endeavour to obtain photographs of the final appearance.

On the whole, he thought that in Class II, Division 1 cases, where there was a loss of two central incisors, it was advisable to remove one lower incisor, but there were some other cases where it was advantageous to keep a well-supported occlusion, for there would not be the tendency for the lower incisors to strike the upper cingula, and the bite would not lose in height and so drive the upper teeth forward again and separate them. During his treatment of the first case he had shown, he had wondered several times whether he should take out the lower incisor, but he very soon saw that it would be wiser not to do so.

Discussion.

Mr. Harold Chapman said he noticed that Mr. Stephens used the word "drastic" in regard to the treatment of removing a damaged central incisor. If by "drastic" Mr. Stephens meant it was best for the patient, then he agreed with him, but if by "drastic" Mr. Stephens meant drastic in the ordinary way he did not know that he agreed with him. Personally he thought the treatment was by far the best. The principle he adopted was to eliminate, as far as he could, the possibility of his patients having to wear any artificial substitutes until there was really no alternative. He could recall keeping the space in only one case, and that was a Class II, Division 1 case, of a very large central incisor. He allowed the space to close up for a short time; then the appearance seemed to be getting beyond anything he could put up with, so he restored the space again, and, of course, the patient had to have an artificial substitute. In all other cases which he had had to treat by removing centrals, he had closed the space.

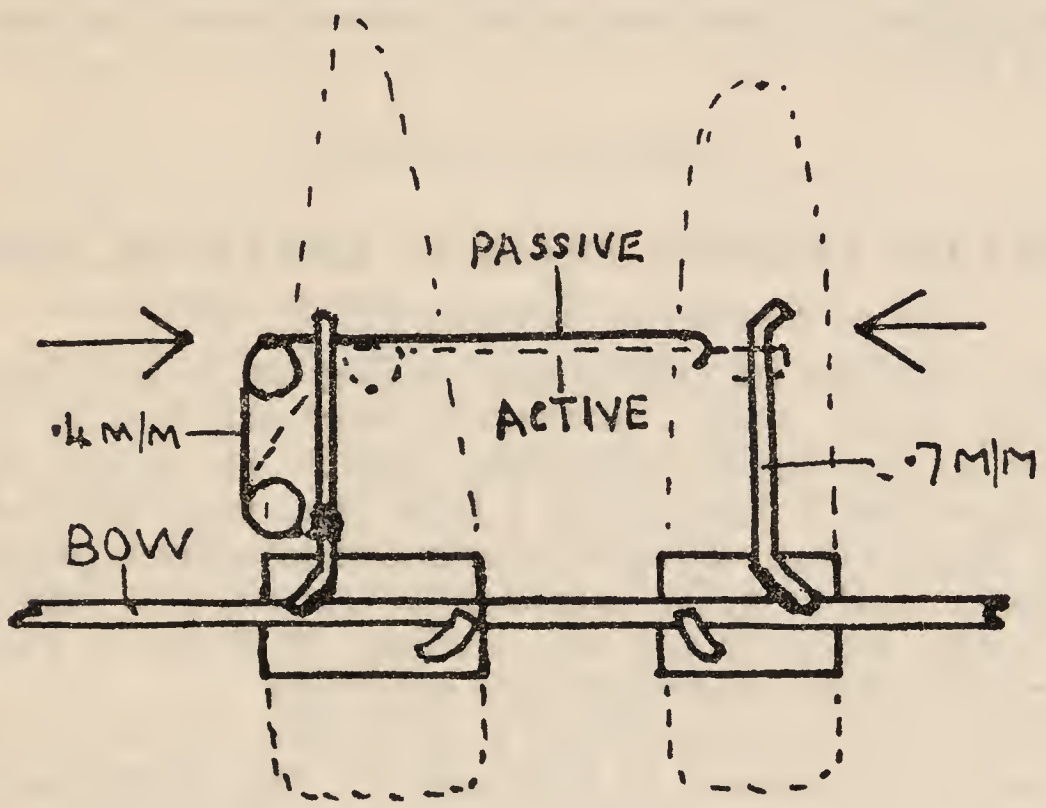
Certain cases of the type in question, in which the central had *not* been damaged, did very well. He had shown one recently at a meeting of the Society. In that case (Class II, Division 1) one central was considerably buccal to any other teeth. In eighteen months the space almost closed without any treatment whatever, and he thought that probably it had entirely closed by now.

He had been extremely gratified by the effect of removing laterals. He found that in Class II cases (Divisions 1 and 2) removal of the laterals in suitable cases allowed good alignment of the teeth to be obtained with little treatment, and the retention was considerably simplified and shortened. Early in the present year he had shown at a meeting of the Society a case of a child (Class II, Division 1) who had had two laterals removed, with very satisfactory results. He was sure that in that case the treatment was a great deal better than wearing an apparatus for many years, as would otherwise have been necessary.

The case might be one in which extreme close bite was present, the lower incisors all coming along up *here* and the upper two canines being locked against the front part of the lower arch. Unless that close bite could be relieved, it was quite obvious that one must treat around *that* space unless the lower arch collapsed or unless one was prepared to collapse the lower arch oneself. If a close bite was present, the prognosis was often best decided by leaving a bite plate in for two or three months, or longer if necessary, when, having got considerable opening, one could actually constrict the intercanine space as well. That all helped in getting the premaxillary part of the upper jaw remodelled on the palliative plan of treatment. If there was

considerable crushing of the front teeth and one front tooth had come to grief, there again the prognosis was very much better. Taking into consideration the case where the bite was open and it was a question of just remodelling the remaining three, quite a ready method was to have a band on the six-year molars with a simple arch of .8 or .9 mm.

The CHAIRMAN said he thought that in most cases, particularly in Class II cases, where there was superior protrusion, if a tooth was damaged or was going to be a non-vital tooth for the rest of the life of the patient, the best treatment was that described by Mr. Stephens. At the present time he had three cases on hand where children had met with an accident. In two of the cases it had been in the swimming baths, the children having dived into the water and damaged their front teeth. One was broken off very nearly level with the gum and the nerve was exposed. In such cases one was faced with either extraction or a crown. In cases where both are possible it is better to get rid of the tooth. He had a very simple and useful little appliance for bringing two teeth together in a parallel fashion. It



was a very easy method and it worked like magic. He thought Mr. Stephens was to be congratulated on his results, which were certainly very much better than those obtained by trying to keep the dead roots.

Mr. ROBERT CUTLER said that Class II, Division 1 cases were exceptionally difficult to treat by themselves, but when an incisor had been lost it often proved to be a complication of the first magnitude. The very nature of the defect of the Class II complex predisposed a child to an accident of that type. One of the most important points was to decide the prognosis so far as successful closure was concerned.

For instance, if the incisor overbite was excessive (so usual in Class II, Division 1 cases), it would be found that the upper canines were more or less locked between the labial aspects of the lower canines and first premolars so that it would be virtually impossible for the remaining three incisors to become nicely rearranged either spontaneously or by mechanical means. In such cases the prognosis would

depend upon the extent to which the incisor bite could be "opened" as by so doing there would be far greater scope for remodelling the premaxilla. Again, a further favourable point in the prognosis was where considerable crowding of the incisors had been present prior to the accident, as the tendency to spontaneous closure of the remaining tooth units would be much more marked. In such circumstances it would seem that the first stage of treatment should be the building up of the bite, as when this was achieved the intercanine space could be actually constricted, this helping the remodelling process whilst at the same time diminishing the risk of tilting the remaining incisor, in so far as less movement of the latter would be required. For this remodelling process a fixed appliance was much to be preferred and could take the form of molar band anchorage to the six-year molars with a free sliding arch passing through a well-fitting split tube attachment to the major incisor unit remaining. Independent movement (towards the mid-line) of such a tooth could be arranged on this arch whilst general retraction of all the premaxillary tooth units was affected by the application of a suitable retracting force to the free sliding arch itself.

Mr. O. Henry said that a certain well-known film star with a wonderful smile had only one central incisor, having lost one when he was a boy.

THE LAST TEACHING PHASE OF EDWARD H. ANGLE.

By A. Thornton Taylor, B.D.S., D.D.Sc.

During a brief but interesting visit to England in the course of a world tour, it has been a pleasure to meet and talk with many members of the dental profession, and in the many pleasant associations that I have made I have been impressed with the interest that has been evidenced in orthodontics abroad, particularly in relation to that great orthodontic teacher, Dr. Edward H. Angle, under whom it was my privilege to study in Pasadena, California, in what was his last student group.

By virtue of this association, I have been interested, though dismayed, at the amount of misconception that exists concerning the life and work of Dr. Angle, particularly concerning his activities in the later and perhaps most productive years of his life.

One might truthfully say that the last decade of his life saw the realisation, in part, of his dreams for his profession, and the establishment of a truly remarkable teaching institution about which very little is really known, particularly in England and Europe.

The truly significant feature of this school was its idealism, its freedom from all restricting influences, the absence of any stigma of commercialism, and the application of idealistic, but practical, teaching methods, designed solely to serve the teaching and practice of orthodontics with students selected under circumstances peculiarly appropriate to Dr. Angle's personality and ideas.

The discipline exacted from students was as remarkable as it was fruitful, and the conditions of tutelage were without parallel in dental pedagogy, and have not to my knowledge been practised, before or since.

In this school Angle departed from the usual practice of giving

short courses of intensive instruction, limited solely to demonstration and practice in technique, and as his clinic developed he found that he could not attain the results he desired in the limited time that the post-graduate student was willing to devote to this study.

Therefore, at first he demanded that students should stay with him for three months and this time was later extended to six months, and then in his last classes he demanded a period of training and study of one year, and no student was admitted to his school unless he was willing to devote this time to the study and practice of orthodontics.

The applicants had to submit to a series of tests and examinations lasting for two or three months in some cases before, or if, the applicant was admitted to the fold. Then began a period of training and discipline, patterned out of fifty years of teaching experience, and absolute subjection to the ideals and practices of the school was an arbitrary requirement, which of course resulted in the graduation of a mind that was moulded according to Angle's ideas. This period of training, although extremely exacting, bore fruit with the ripening experience of later years of practice, because the element of confusion was eliminated from the student's mind, and although in many cases this may have led to dogmatism, yet it cannot be denied that it was a splendid principle in training and preparing an orthodontist for a profession which to the present day presents a maze of controversy in which an ill-prepared mind is quickly and hopelessly confused.

That there were no fees at all in this college and clinic, is in itself, perhaps the feature that has excited most interest among orthodontic leaders both here and Europe. By this means, of course, Angle was able definitely to select his students as well as his patients, who also paid no fees, although treated with the most costly appliances and in the most conservative manner. This cost was borne by the students, as well as the routine expenses of the clinic—telephone, light, gas and so forth. The cleaning and chores were done by the students themselves, which task, although at first universally resented, was in after years to be appreciated as a splendid discipline to have endured and a great help in the ordering of their own offices.

The lecturers, recruited from Angle's graduates who had settled into practice in Southern California, also did their work gratuitously, and came regularly to deliver lectures in the subjects assigned to them.

Dr. Angle himself in all cases taught the technique peculiar to his methods in a manner in which, I am sure, he had no peer. The hours on end that he would sit with a raw and clumsy student inculcating in him the refinements of his art was a thing of wonder and admiration to all who came in contact with him, then a man past his seventieth year.

In this school there was not the slightest suggestion of the commercialism that is, and has been, a feature of post-graduate teaching in dentistry.

Here, in Pasadena, in his last ten years of teaching, Dr. Angle carried on his work out of devotion to his ideals for orthodontics. He strictly limited his classes, and there were never more than

six students with him in one group. His last class consisted of four, and at the termination of this class in the early part of 1927 Angle retired finally from his little school, and it was my sad privilege to close for the last time the door of this unique establishment—a home of orthodontic teaching raised from the ideals and devotion of Angle and his students.

Though I regret to say it, it is evident to me, through contact with orthodontists in Europe as well as in Great Britain, that there unfortunately exists much misconception concerning this orthodontic teacher. It is very apparent to me that much controversy has raged round things which I feel sure the critics have not fully understood or appreciated, but I feel it is beyond the scope of this Communication to discuss these things.

Angle found difficulty always in expressing clearly what he meant, and this fact alone, particularly in relation to his celebrated "classification of malocclusion," has led to a very general misunderstanding of its essential principles. I know this to be true from conversation and observation with orthodontists and dentists in many places, but I must refer the reader to other publications for elucidation of these facts.

If this short note has helped to clear up any misconception that may have obscured the value of, more particularly the late work of Dr. Angle, then I feel that I have done a little to repay the lasting obligation I owe to this great orthodontist.

PARASYMPATHETIC DOMINANCE AS A CAUSE OF MALOCCLUSION.*

By F. W. Broderick, M.R.C.S. Eng., L.R.C.P. Lond., L.D.S. Eng.

A year or so ago our secretary, Mr. Robert Cutler, read a paper before this Society entitled " Post-normal Occlusion as a Manifestation of the Lymphatic State." I was not a member at that time, and was not present to take part in the discussion which followed, but there was so much in the paper with which I was in agreement that when he asked me to contribute something to this meeting, I felt that I should like to reopen the subject once again, giving it, perhaps, a wider background.

I present this paper with some diffidence, in that I appreciate my ignorance of the subject of orthodontics as it appeals mostly to the members here ; nevertheless, possibly I may be able to interest you for a short while, by presenting a new approach to the ætiology of those conditions which it is the purpose of this Society to study : an approach built upon the study of bio-chemistry and bio-physics, the teachings of which I have attempted to correlate with dental pathology.

Mr. Cutler built up his argument, in the paper mentioned, along the lines of inherited diathesis, as something giving a special type of metabolism to an individual, the consequences of which were to bring about a certain well-recognised deformity of the jaws which resulted in post-normal occlusion. He described the characteristics of the child—the subject of this diathesis, and then proceeded to show that a large proportion of children with post-normal occlusion were of this particular type.

Now, I have interested myself in this matter of constitution and diathesis for a number of years, and have considered it in its relation to the ætiology of the common dental lesions of caries and of pyorrhœa. Since reading Mr. Cutler's paper I have taken note of those cases of post-normal occlusion which have come my way, and have noticed that, in a very, very large proportion of the comparatively small number of cases which I have seen, the teeth which the children possessed were extremely good ; in fact, there would seem to be a definite immunity from caries in cases of post-normal occlusion. If this is indeed so, and if there is any truth in my hypothesis as to the cause of dental caries, which I shall presume is well known to you, then this fact might possibly be an important guide to the ætiological factors which bring about this condition.

Mr. Cutler dealt only with end-points, the beginning and the ending, the lymphatic state and the malocclusion ; he made no attempt to explain the cause of the former, the underlying causative

* *Transactions* of British Society for the Study of Orthodontics, 1934.

factors on which the metabolic inefficiency rests, nor to trace the production of the maldevelopment of the jaws in relation to this inefficiency. I agree, as did a number of the speakers on that occasion, that there is a definite connection between the two states, and should like to take this opportunity of placing before you my ideas as to the causation of the diathesis, in the first place, and to suggest how, possibly, this might be productive of the changes in the dental apparatus which eventually come about. In the course of this discussion it may be possible to throw some light upon the seeming exceptions which were so stressed by the opponents of Mr. Cutler's hypothesis.

I have brought to your notice this evening an ultra-microscopic blood picture, demonstrating the colloidal protein particles of the blood plasma. These constitute the matter primarily concerned in the processes of metabolism, the interchange taking place at the interfaces of the colloidal particles, and as the chemico-physics of matter in the colloidal state is probably unknown to the majority of my audience, perhaps I may be allowed to give just a brief summary as an explanation of that picture.

All matter in dispersion is either in solution—that is, in molecular dispersion, in coarse dispersion, or in the colloid state—the difference depending upon the size of the particles. Sugar dissolves in water, and is an example of molecular dispersion ; sand does not dissolve, and slowly settles out, the particles precipitating and falling to the bottom of the vessel holding the water. Between these two types of dispersion lie limits within which matter is neither in solution nor in precipitated particles, but is present in minute dispersion in what is known as the colloidal state. Quite arbitrarily the size of a colloidal particle has been fixed as being between 0.1 of a micron and 1.0 of a millimicron ; a micron being 1/1,000 of a millimetre. The colloidal particles, therefore, lie within the limits of 1/10,000 and 1/1,000,000 of a millimetre. Particles of this size are invisible under the highest power of a microscope, but they are too large to pass through the pores of a parchment membrane : they are, however, visible with the ultra-microscope, which differs in principle from a microscope in showing not the particles themselves, but their reflected images. The principle of the ultra-microscope is, in fact, demonstrated by the beam of light passing through a hole in a window blind and falling into a darkened room. You are all familiar with the particles of dust which this makes visible, but what you are seeing are not in reality particles of dust, which are invisible outside the limits of the ray, but their reflected images.

Matter in molecular solution is invisible even with the ultra-microscope, and the particles are small enough to pass through a parchment membrane, this constituting matter in the " crystalloid " state, as differentiated by Graham ; on the other hand, matter in coarse dispersion has particles which when not visible to the unaided eye are visible under an ordinary microscope.

Thus we see not only that there are three kinds of matter in dispersion, but that with matter in the colloidal state itself we may have particles of different size within the limits in which this state is possible.

Now, matter in this form possesses certain chemico-physical characteristics which differentiate it from all other, to which are due all the possibilities of life ; in fact, life is only possible through the colloidal state, all living matter being colloidal, and as soon

as it ceases to be so, death supervenes. Schade says : " The physico-chemical investigation of the human body extends far beyond the cellular pathological concept of Virchow.

" As in the case of all branches of biology, medicine, thanks to the quickening influence of colloidal chemistry, is on the verge of a new era. Medical research has broken a road for itself in still another direction ; instead of the earlier humoral pathology, which explained all disease upon the basis of a disturbance of the ' humors,' there arose a cellular pathology, as a consequence of the development of the microscopic technique, according to which the cell was regarded as an entity controlled by its own laws, whose independent behaviour was ætiologically determinate. To this conception we could apply the old principle of Virchow : ' If the matter is to be understood and the details grasped, nothing remains but to go back to the elementary constituents ; and the elementary constituents for the chemist are atoms, for the physicist molecules, and for the biologist cells.' Now behind the cell we find the micellæ as part of a colloidal system, so nothing remains but to go back to them. Everywhere in the body, in the cells, in intracellular tissue, in the blood, in the body fluids, are found colloids ; practically every process bears the imprint of their individuality. Striking new results of far-reaching importance have led a not inconsiderable number of physicians to believe that in colloid research lies the key to profound penetration of the mysteries of ætiology. The vivification of medicine by colloid chemistry justifies us in calling this a new era in medicine."

The chief importance of matter in the colloidal state in the living body lies in the enormous development of surface area which it brings about. In much the same way as the tree develops surface area by the output of its leaves, so that a single large tree in full foliage in reality covers many acres of surface, so the body of a single person, on account of colloidal dispersion, would cover square miles of area at the intersurfaces of which energy production comes about. Consider the surface of a cube of metal, each surface of which is 1 cm. square, giving thus 6 sq. cm. If this were divided into smaller cubes with sides of 1 sq. mm. the whole surface area would be 60 sq. cm. If it were subdivided into a billion little cubes of a thousandth of a millimetre, or 1 micron to a side, the total surface area would be 6 sq. metres, and still it would be a coarse dispersion and not colloid. If subdivided into millionths of a millimetre, which would be within the limits of matter in the colloidal state, the surface area would be roughly an acre and a half.

In addition, however, to the enormous increase in surface area, and the number of interfaces which the colloidal state makes possible, certain other characteristics are inherent in particles in this state of dispersion, the most important of which is that of the power of adsorption of ions from the medium in which they are dispersed, through which the processes of metabolism, the turning of food into energy, is brought about. We have to consider not the colloid micellæ as separate and distinct things, so much as the relation of these micellæ to the medium by which it is surrounded, any change in this medium immediately affecting the character of the micellæ themselves, and through change in surface tension, enlarging or diminishing their size and characteristics, and therefore their metabolic possibilities.

We have seen that the colloidal state may exist with particles differing in size from that of 1/10,000th to 1/1,000,000th of a millimetre. In this difference lies the story of constitution and diathesis. As the particles approach the size of true solution, in molecular form, at one extreme, or those of a coarse dispersion at the other, which will depend entirely upon the constitution of the surrounding medium, so will alter the whole character of the individual, metabolic, chemical, physical, and psychological.

The colloidal particles have been compared, by analogy, with solar systems ; in the centre, as representing the sun, lies a positive electrical charge, the proton, around which revolve the satellites, held in position by varying degrees of attraction ; these are formed of the adsorbed ions. In the outermost orbit lie electrons, particles of negative electricity ; next in position lie the inorganic salts, next sugar, then urea and uric acid, followed, still from without inwards, by the amino acids and the fat. With perfectly functioning particles all these constituents are firmly held to the nucleus, but under certain conditions they tend to pass out of the colloidal complex, loose, as it were, into the surrounding medium, as the adsorptive power of the particle diminishes. When the colloidal complex tends to break up in this manner, as the result of changes in the dispersal medium, away come the constituents from without inwards according to the amount of disturbance, the particles tending to get progressively smaller until they eventually go into true solution. On the other hand, the particle may enlarge, due to changes in surface tension, when they will hold their constituents still closer, adsorbing more from the surrounding medium, in which case these latter may even tend to disappear from the blood plasma, and, being changed from crystalloid into a colloid state, will be incapable of being differentiated by ordinary analysis. This is the explanation of such conditions as hypoglycæmia or hypocalcæmia on the one hand, and of hyperglycæmia and hypercalcæmia on the other. Further, as the particles enlarge, the total surface area diminishes and metabolic processes slow down.

As, when particles get smaller in this way and lose their adsorptive powers, they give up water, and when they enlarge and increase their adsorptive power they take in water, McDonagh speaks of them as dehydrated and hydrated particles.

In this way we get three kinds of colloidal particles : the normal, that is as small as is consistent with the colloidal state, giving a normal adsorptive power and enormous surface area ; the dehydrated particles, still small but not perfect particles in that they have lost adsorbed constituents ; and the large, hydrated, particles with increased adsorptive power, and lessened surface area. These can be differentiated with the ultra-microscope, as they also offer other differentiating signs, with which we have not time to deal this evening.

I have said that the characteristics of the colloidal particles depend essentially upon the constitution of the dispersion medium in which they lie. The chief changes in this will be its reaction, the amount of hydrogen ions which it contains, designated its pH ; the proportion of ions of the mono-valent and the poly-valent salts, mainly those of sodium and potassium on the one hand and of calcium and magnesium on the other ; on the balance of circulating hormones, and of the autonomic innervation of the tissues, whether

this be primarily through fibres of the sympathetic or of the parasympathetic. Further, as this innervation is antagonistic, the one stimulating to activity and the other inhibiting any particular function or organ, according as to whether it is conservation or expenditure of energy which is necessary at the time, it will be seen that the whole colloidal system, i.e. the particles themselves and the inter-micellary liquid, will be constantly in a state of change, alternating backwards and forwards according to the necessities of the moment.

Now all these circumstances taken together, the pH of the tissues, the ionic balance, the hormonic balance, the nervous innervation, and the state of the colloid particle, all reacting the one with the other, make up what is known as the vegetative system, on which depends metabolic activity.

It will be within your knowledge that I have fathered the hypothesis that the dental lesions of caries and of pyorrhœa depended ultimately upon vegetative balance. It is true that when I commenced thinking upon these lines I considered only the matter of tissue reaction, acidosis on the one hand and alkalosis on the other. As my knowledge grew, however, I appreciated the fact that this could be only one part of the story, that these conditions, clinically at any rate, represented only symptoms, themselves dependent upon other circumstances. This observation carried me back to the autonomic nervous system associated with hormonic influences ; here again one found that one had not reached bedrock, it was still necessary, following Virchow's method, to get back to elementary constituents, so I took up the study of colloidal chemistry, which united all these factors which I had previously considered into the vegetative system as conceived by Zondeck and Krous. Further back then the colloidal system it is impossible to go for these are the ultimate particles of life.

Now vegetative imbalance, designated sympathetic and parasympathetic status, or dominance, and including not only excessive sympathetic or parasympathetic innervation (as visualised by Eppinger and Hess) but the whole matter of colloidal disquilibrium : reaction, ionic, and hormonic imbalance, becomes the basis of diathesis or altered constitution, giving the fundamental threshold not only to dental, but to all general and systemic disease, through changes in metabolic efficiency, primarily through capillary reactions and permeability which this will bring about. Here we get, not only why, but how, the recognised changes take place.

Ramsey, considering the onset of disease, says :—" Biochemistry and biophysics have taught us that the living body is an admirably equipped laboratory in which nature is continually performing experiments. When they are successful we are not conscious that anything is happening, everything goes like clockwork, and we feel in good health. When, on the other hand, the experiments fail we become aware of unpleasant sensations, which we have learned to recognise as symptoms of disease. Health, therefore must be considered as a dynamic rather than a static state. We keep healthy as the result of a perpetual struggle to maintain physiological equilibrium in the reactions constantly taking place between the cells of the body and the nutrient capillaries. Physico-chemical changes, therefore, which originate in the capillary system, are the first departures from health, and the cause of the earliest symptoms of disease.

"The part played by the capillaries is quite distinct from that played by the heart and the other blood vessels, all metabolic interchanges taking place through their walls; consequently they form the most active, purposive, and dynamic part of the vascular system. Their contractility is controlled not only by the vasomotor nerves, but also by chemical stimuli, the former acting as a coarse, the latter as a fine, adjustment. The capillaries are not simple tubes through which blood flows. They do not respond to the amplitude of the pulse-waves in the arteries. They are really a constituent part of the tissues in which they lie, and their blood circulation is regulated and controlled by the requirements of the individual cells of the structures which they supply. All the important business of life is transacted through the walls of the capillaries."

Now, capillary activity is controlled by the vegetative system, as we have just considered; the sympathetic status representing a state of tissue activity with contracted muscle fibres, and therefore with contracted capillaries, with diminished permeability of the capillary walls, calcium accumulation within the cell, increased acid formation, increased thyroid and adrenal activity, and a dehydration of the colloidal particles of the blood plasma; whereas the parasympathetic status represents just the opposite: muscle relaxation, dilated capillaries with increased permeability, calcium dissimilation, alkaline reaction, diminished activity of the thyroid and the adrenals, and an hydration of the colloidal particles. Thus, although it must be appreciated that these are constantly interchanging the one with the other in the processes of life, sympathetic being replaced by parasympathetic activity, it will be seen that with a constitutional, inherent tendency to over-activity of the one or the other, one set of functions, katabolic or anabolic, will, in some degree, tend to overbalance its antagonist, giving a definite trend to individual metabolism. In this way we get a glimpse of individuality, in health or disease, as set by vegetative balance or imbalance. But it is not quite so simple as this might seem to suggest, in practice it never is, for although it is easy to conceive extreme cases of sympathetic or parasympathetic predominance affecting every organ and tissue, this rarely eventuates. With sympatheticotonia it is much more common to have the whole of the body affected at the same time, as is seen in adrenal or emotional shock, when we get a typical picture of sympathetic predominance, but the parasympathetic does not, as a rule, work quite in this way, on account of certain anatomical differences in its build, here certain functions or organs only, innervated by the parasympathetic part of the autonomic nervous mechanism, may show deviations from the normal, the remainder behaving normally. For instance, should this be the lungs asthma may come about, if the nasal mucous membranes hay fever, if the organs in the portal area hyperchlorhydria or mucous colitis, and so on. Thus the symptoms of a constitution essentially parasympathetic need not always be the same, in some these may refer to one set of organs or functions, in others to another.

Mr. Cutler picked out one type of parasympathetic status, the dull, heavy child, predominantly anabolic, with enlarged lymphoid tissue, waterlogged, and deficient of thyroid secretion, but all parasympathetic dominant individuals do not show these characteristics. Mrs. Lindsay and Mr. Steadman criticised Mr. Cutler's

hypothesis because they found post-normal occlusion in persons who do not conform to his class, which I suggest he made too narrow, and, on the contrary, because they have found this same deformity in persons of another type, which they make too wide ; this does not, however, mean that these are of the opposite type, the sympathetic, but rather that their parasympathetic dominance did not affect the particular organs which Mr. Cutler had stressed. It is true that Mrs. Lindsay called these children acidotics, but it is so easy to go wrong in attempting to classify children from obvious signs only. For instance, I have quite recently investigated a young man of about 21, active, bright, pale, and anæmic looking, subject to asthma and hay fever, with beautiful teeth, who gave all the characteristics of parasympatheticotonia, and hydrated colloidal particles. He might easily have been called an acidotic by a person with incomplete knowledge, which he certainly was not, indeed he was highly alkalotic.

Again, constitution, the consequence of inheritance, is not the whole story, this simply sets the threshold from which the strains and stresses of life commence to act ; it is these latter which bring about the signs and symptoms of disease, and if the stresses are not present the special characteristics will not appear ; if these should be of the opposite kind, and severe enough to overcome constitutional tendencies then the opposite signs may show themselves. These stresses, for example, may be dietetic, carbohydrates tending to dehydrate the colloidal particles and therefore to shift the patient to the sympathetic side ; if he be predominantly parasympathetic to commence with no ill-effects will come about, but if sympathetic in tendency but a small surplus of carbohydrate will be productive of exaggerated signs, as in caries ; if, however, the carbohydrate feeding is very excessive, and the parasympathetic dominance but small in amount, this may be sufficient to pass the child over to the sympathetic, although he be constitutionally parasympathetic.

All the difficulties encountered in appreciating this approach to the ætiology of disease revolve around what we mean by the word disease. Is this to be limited to end-points only ? Are we to consider, say, chronic interstitial nephritis as a disease, and all the circumstances which slowly lead up to the formation of fibrous tissue within the kidney as health ? Surely not, yet medicine, as at present practised, is not interested in, and cannot diagnose, disease until it has reached an end-point, with damaged organ or changed function. As dentists we are equally blameworthy, we diagnose a tooth cavity as caries, but all the circumstances which have led up to the enamel decalcification we perforce disregard, yet the latter in reality constitute the carious process, the former being just an end-point.

I once stated in a paper that we had not the slightest idea as to what was meant by disease, and the sentence was censored out by an indignant sub-editor, who was quite certain that he, or she, knew all about it, but I, most humbly, beg to differ.

Disease, like health, is a dynamic and not a static process ; a deviation from the normal in physiological processes, which slowly and inevitably lead up to organic changes, which themselves are not diseases but the consequences of disease ; and these deviations are the result of changes in vegetative balance, which alone constitute disease at its onset.

I have shown you an ultra-microscopic blood picture, the basis on which vegetative stability or instability is built. Of course, the matter is by no means as simple as one of hydration or dehydration of colloidal particles. I have no opportunity at this time to go further into the details and altered pictures in disease, such as would be presented in different conditions. It is, however, along the lines suggested that all disease commences, whether this be dental caries or pyorrhœa, allergy, arthritis, or even susceptibilities to this or that infection.

The physiological dehydrators and hydrators of the colloidal particles, through which the body attempts to maintain a stable vegetative balance, are the hormones and the vitamins, which thus come into the picture medically and scientifically. It is not enough to diagnose an hormonic deficiency or excess, or a vitamin deficiency at one end of the scale and the fully developed lesion, medical or dental, at the other, and think that the whole matter is solved. There obviously must be intervening links through which the one or the other bring about the end-point.

As a leader-writer in the *Lancet* recently stated: "The difficulties met with in our understanding of diseases of nutrition are, to a large extent, the legacy of a not very fortunate conception of specific deficiency diseases which was put forward in the early days of the study of vitamins. This conception which finds expression in such terms an anti-rachitic, or anti-infective vitamins, postulated a direct causal relationship between vitamins and certain diseases. The disease was supposed to spring into being without any intervening pathological changes as soon as the vitamins in the food were withdrawn and any reserves within the body exhausted. At present it is widely believed that rickets, for example, must necessarily appear when the anti-rachitic vitamin is not present in the food in sufficient quantity. But Sherman and Pappenheim published experiments nearly ten years ago showing that rickets does not occur in the absence of vitamin D if the proportion of calcium and phosphorus in the diet is kept near the optimum point. The real function of the vitamin is to correct the absorption and assimilation of calcium and phosphorus when these are not supplied in suitable proportions. The term anti-rachitic vitamin is therefore misleading in so far as it gives the impression that the absence of this vitamin must necessarily be followed by the disease."

As a matter of fact Hahne, and also McDonagh, have shown that the vitamins act solely through their effect upon the surface tension of the colloidal particles; vitamin D, for instance, being a hydrator, that is increasing parasympathetic effect, increasing alkalinity, and drawing into the colloidal complex the calcium, whereas vitamin C acts as a dehydrator with the opposite effects. Hormones, similarly, act through the colloidal system, the thyroid and adrenals being the natural dehydrators. If we consider this carefully we shall see how these various substances bring about the changes within the body associated with their excess or diminution, through vegetative activity, stimulating or depressing metabolism, increasing katabolism or anabolism, and regulating the conservation or expenditure of energy.

The action of insulin McDonagh believes to be that of a dehydrator. It is usually believed that this substance acts primarily upon blood sugar, thereby regulating carbohydrate metabolism.

From what has been said it will be seen that in the act of hydration the colloidal particles will draw sugar more firmly into the colloidal complex, in which form it will become unrecognisable to ordinary methods of analysis; consequently an hyperglycæmia would be made to disappear, or even to be replaced by a hypoglycæmia on the administration of insulin, without this substance being in any way specific to blood sugar. When we come to consider that the methods which, experimentally, will prevent insulin shock, usually considered to result from hypoglycæmia, are the giving of dehydrators, of which glucose is one, but oxygen subcutaneously, and many other substances such as adrenalin are others, we see that the matter of sugar as such does not primarily come into the story. As a matter of fact, I have used this idea in the treatment of excessive caries in non-diabetic young children: if dental caries is due, as I believe, to an acidosis, to a predominance of sympathetic function, to a dehydration of the colloidal particles, then hydration should be the preventive treatment. I have found in the small number of cases in which I have been enabled to experiment, that daily doses of insulin over a period of two to three weeks brings about the definite clinical entity of "arrested decay," without any other change whatsoever in the daily life of the children. This is not the opportunity to further discuss this matter, as there are certain difficulties to be overcome, but I submit that it does definitely prove my hypothesis.

In this way, with a visualisation such as is here presented of disease in its onset, we are enabled to see just how a particular constitution, resulting in a peculiar metabolic activity, links up various symptoms and end-points. Cutler finds, as do others, that what he has described as the lymphatic diathesis, is frequently associated with a certain type of malocclusion. There are exceptions both ways, as there are bound to be if one attempts to draw conclusions too rigidly, without taking into consideration all the factors on which the association rests. For example, I recently had a small boy sent to me for advice as to the prevention of very rapid caries. By constitution he was a parasympathetic dominant, but on investigation one obtained figures of acidosis, sympathetic predominance, and dehydrated colloidal particles. The history, however, solved the seeming paradox. The boy had had frequent attacks of angio-neurotic œdema, a definite parasympathetic syndrome, he would have gone into Cutler's group of lymphatic, waterlogged, thyroid-deficient children. His teeth had been exceptionally good until a year or so ago, when they started to go wrong, the reason, incidentally, why he was referred to me, at about that time he had had a very severe attack of measles, so severe indeed that he nearly died of bronchopneumonia, this was followed in a few weeks by whooping cough, to which naturally his parasympathetic constitution would not make him immune, although it would alter the character of his reaction to the infections. The consequence of these illnesses, naturally, would be to swing his metabolic activities over to the sympathetic side, giving him a tendency to caries although his primary characteristics were parasympathetic.

But when we find, as I believe we do find, that generally speaking the teeth of these children with post-normal occlusion are of exceptionally fine quality and to a very great extent are free from caries, we get yet another association with parasympathetic

status. And when we go one stage further and find what I believe is a recognised after-effect of treatment—pyorrhœa supervening in middle life, so frequently attributed to excessive movement of the teeth and damage thereby to the periodontal membrane, but obviously, according to my conception of ætiology, due to the constitutional imbalance which was productive of the "lymphatic" state and of the caries immunity—the whole of our difficulties of causation fades away. Here, then, we have the *why* these conditions are associated, we have still to consider *how* the parasympathetic state brings about the changes which result in post-normal occlusion.

Here, I am afraid it is impossible to be dogmatic, all that I can do is to point out the effect of this condition upon calcium metabolism, upon the ossification and resorption of bone, leaving you with your greater knowledge of the strains and stresses to which the growing maxillary and mandibular bones will be subjected in cases of lymphatic overgrowth, and swollen and congested mucous membranes of the throat, to work out how this abnormality might come about.

We have seen that the chief effect of alterations in vegetative status are dependent upon changes in the activity of the capillary system; that with parasympathetic dominance these are more dilated and permeable, with increased circulation to the tissues supplied. Leriche and Policard point out that bone is not, in reality, the fixed immutable tissue which we are sometimes inclined to believe it to be, but that it is always in a state of flux, taking up, or giving out, lime salts according to the needs of the body at any particular moment; that the bones, in fact, are the great calcium reservoir of the body. They say: "Important relations connect bone resorption with an increase in the blood circulation; wherever this is increased there will tend to come about resorption of bone, and where it is diminished an ossification. The calcium thus freed becomes available for ossification elsewhere within the neighbourhood. The important factor in the stability of bone seems to be circulatory efficiency." When we come to consider the effects of experimental and surgical alteration of local vegetative balance, such as is brought about by the operation of sympathectomy, the cutting of the nerve fibres containing the sympathetic nerve supply to a particular area, we see that this is upheld. Quoting these same writers again: "In an entirely empirical way we can to-day consider it as established that periarticular sympathectomy at a distance modifies the region in a definite way. In fact, it is followed, experimentally, by a rapid ossification in the fractured zones (of bones) and, clinically, by a reossification of regions in too active resorption, where there is no utilisation on the spot of the freed material. With all the reservations which the insufficiency of our knowledge imposes one can say that periarticular sympathectomy precipitates bone resorption, and thus permits ossification, but that these phenomena may pass beyond bounds. Events take place as if there were, for the preservation of bone, an optimum of circulation which this operation modifies in a direction which is always the same, but in a quantity that we do not know how to proportion."

Now the condition produced by sympathectomy is obviously one of parasympathetic dominance in the area affected, the removal of sympathetic stimuli allowing the antagonist, the parasympathetic,

to have complete control; consequently we have in these cases changes in bone deposition and removal which could presumably affect such parts, in growing bones, as the glenoid fossa and rami of the mandible, should these be subjected to certain stresses such as might be produced by diminished airways, which themselves might be the consequence of the same disturbance.

Mr. President, I feel the inadequacy of this paper very strongly, my excuse must be that the subject is too large for a single contribution. I am at present engaged in an attempt to deal more adequately with the matter in the form of a book, where my stage is so much wider. If I have been enabled to interest any of the members of this Society in a new approach to the ætiology of malocclusion they will, at their leisure, be able to follow up the suggestions which I have brought forward this evening.

Discussion.

Mr. R. Cutler said that some years ago he had had the temerity to read a paper to the Society dealing with the application of modern pediatrics to the study of orthodontics. That paper had met with a rather cold reception, a number of members of the Society feeling themselves quite unable to lend support to his views. He had not been at all discouraged, however, as he had realised that the fault lay with himself in not making his meaning fully clear at the time. In his opinion, subsequent experience had entirely confirmed the truth of the views he had expressed in his paper, and it was rather pleasant to him to hear those views supported on the present occasion by someone who was not an orthodontist but had arrived at his conclusions on general reasoning. Mr. Broderick had rather taken him to task for having made such a limited survey of an exceptionally deep subject, and he was afraid that that kind of reproof must be given to many junior colleagues who started investigations upon subjects of orthodontics or general dental interest. The reason for that was that practising dentists had little or no scientific background to enable them to approach the study of complex problems, such as the one under discussion that evening, at all efficiently, and, even if they had, the stress and strain of conducting general or specialised practice under modern conditions entirely sterilised the enthusiasm they might have felt during their earlier years. That was probably one of the troubles that beset the study of orthodontics at the present time. There were, on the one hand, expert clinicians and technicians, who went on perfecting their art more and more and obtaining beautiful results, often obtaining those results, probably, in a way that they could not explain, and, on the other hand, there were the completely academical workers, who probably knew nothing at all about orthodontics and who might know nothing about dentistry even, but who carried out a great deal of research work upon jaw growth and other subjects of tremendous importance to orthodontists. There were very few people who combined a practical knowledge of orthodontics or dentistry with a really scientific background and who could thus act as liaison officers between the two opposing groups. There were technicians like himself on the one hand and, on the other hand, there were workers in medicine and pathology and embryology who were doing a great deal of excellent work on matters which might be very relevant to the practical side of orthodontics, but there was no one to focus their energies and abilities on lines that would be of help to orthodontists. Whether the members agreed with Mr. Broderick's views or not, they should be extremely grateful to him for presenting new viewpoints on old subjects. Mr. Broderick's paper at least made them take stock of the older explanations of disease and abnormality which had so easily satisfied them in the past. It was not so many years ago that enlarged tonsils, adenoids, mouth-breathing, etc., were

regarded as being the direct cause of, or in direct relation to, the Class 2 condition. At the present time any such connection was spoken of with great diffidence by those who knew most about the subject, and rightly so, but similar ideas had been tamely accepted up to the present, and now, as a result of recent work, whether it was correct or not, orthodontists were at least beginning to question the truth of the old explanations. Dealing more specifically with the subject matter of the paper, he might say that there was one practical point which appealed to him, i.e., the marked resistance to caries of Class 2 cases. Those who did much hospital work, whatever the disadvantages of that might be, had at least the advantage of seeing the end-points or extremes that disease and metabolic maladjustments might cause. That advantage was denied to the practitioner in specialised practice, who dealt with children brought up under the best possible conditions and who very rarely saw the end-points of disease, and who might therefore miss certain basic fundamentals. If those who carried out hospital work reviewed the Class 2 cases which they had seen at a hospital during the course of a week, he thought they would agree that those cases had a very high resistance to caries. There was a practical reason for that, namely, that a Class 2 case in which, for instance, the lower six-year molars had been lost as a result of caries was, from the standpoint of the technician, virtually untreatable, and therefore such as would be turned away. If, however, the members reviewed the Class 2 cases which they had seen in the last week or month or year, they would find there were really very few cases which they felt they could turn away as being technically impossible to treat. Secondly, Class 2 cases seemed to develop a degenerative gum condition which might lead on to pyorrhœa, for instance, and, again, that condition seemed to develop whether the case was treated or not. Those were two practical points in connection with the subject under discussion, and apparently Mr. Broderick had an adequate explanation for them, which so far had not been given by any other authority. It so happened that the resistance to caries and the tendency to develop a gum condition were clinical signs which were obvious to an ordinary dentist like himself, but he was quite certain that to the skilled biochemist there were many other more subtle manifestations of metabolic and other forms of growth maladjustment which dentists missed and which they would continue to miss until a closer co-operation was brought about between the two entirely opposing forces in orthodontics at the present time. Personally he would be very grateful if Mr. Broderick continued his work on general matters, and, if Mr. Broderick had time to carry out further researches in orthodontic problems, he thought it would be eventually of great benefit to orthodontists.

Mr. Broderick said the whole subject was built upon the question of the inherent diathesis or constitution which an individual possessed from birth or before birth. It would be remembered that the medicine of a hundred years ago was essentially built upon constitution and diathesis, and pathology dealt with various types—the strumous type, the tubercular type, the lymphatic type, the nervous type, and so on. Then there came the work of Pasteur, and diathesis went out of fashion. It seemed as if medicine was on the eve of something which might be called specific ætiology, a definite division of disease and a definite division of causation, all disease caused by micro-organisms and every disease caused by a different specific micro-organism. The hope of that had been disappointed, and it was now known that, over and above the question of a specific micro-organism or any micro-organism being the cause of disease, there was a great deal to be said for the soil, the individual himself who became infected with the micro-organism. The question of soil was a question of diathesis, a question of individual constitution with which the patient was born. It was not quite such an easy matter—taking acidotic

fathers and mothers and expecting to find acidotic children. There might be something of the Mendelian Law in the matter, but he himself had three children, two of whom were definitely parasympathetic and one definitely sympathetic. If people were to be divided along the lines suggested, that would mean that he was sympathetic and his wife was parasympathetic. The definite constitution which regulated the metabolism of the individual and his reaction to disease throughout the whole of his life was something inherent in him. It was most noticeable, of course, in the extremes, the extreme parasympathetic dominant and the extreme sympathetic dominant. There were many other forms of classification, such as the acidotic or the alkalotic, or, coming to McDonagh's views, the hydrated or the dehydrated individuals, with reference to the state of the protein particles of their blood, which McDonagh believed to be the essential difference in the reaction of every individual to disease. He would suggest that even the earliest type of malocclusion or the earliest stage at which a dentist saw it was an end-point. In that connection he did not agree with what Mr. Cutler had said, that in hospitals the end-points were seen, whereas private practitioners did not see end-points. Personally he contended that all the stages were end-points. Leading up to the end-point was the constitution of the individual from the moment of his birth, and then there entered into the question such things as calcium metabolism, giving a mandible which would react differently to various strains and stresses. He could not enter into a discussion on that subject, because he knew nothing whatever about it. If the members present would bring forward the difficulties which they felt in understanding what he was attempting to talk about, it would help him very much in explaining the matter. Having been dealing with the subject for the last twenty years he found it a little difficult to appreciate the points which some of the members might not understand, as they had become to him quite simple matters.

Mr. Bradlaw asked if Mr. Broderick would state what physiological evidence there was for the existence of a sympathetic and a parasympathetic system which were physiologically antagonistic. He did not know why they should be regarded as pulling in different directions. Unless the members could understand that fundamental point, he did not think they could grasp Mr. Broderick's learned argument. With reference to the liaison between the research worker and the clinician to which Mr. Cutler had referred, an attempt was being made at the present moment by the British Dental Association to bring about such a liaison, so that the pure research worker, the physiologist and the pure scientist might be put into touch with the needs of the clinician. He felt it might be possible for the Society to do something along the same lines to make known the needs of clinical orthodontists.

Mr. Broderick said that, with regard to the evidence of a nervous system built up of two antagonistic parts, without having time to think the matter out along proper lines, he would make the following suggestion. There were present at the meeting that evening individuals whose pulses ran in the sixties and the low seventies and others whose pulses would always be in the high seventies and the eighties. If the individuals in the latter class were treated with drugs which stimulated the sympathetic, their pulse rates would go up. There were patients to whom an injection of adrenalin, for example, would give a mild shock, and there were patients who could be given very much larger doses of adrenalin without any fear of shock. Obviously those who were affected by adrenalin were the sympathetic dominants, in whom normally the adrenal secretion was marked, and those who were not affected by adrenalin were the parasympathetic dominants, whose adrenal and thyroid glands were relatively inactive. Taking the patients with normally quick pulses, their pulse rates would be reduced by injections of atropin, which paralysed the vagus. It was from

pharmacological experience the Eppinger and Hess of Vienna built up the clinical differentiation between the two classes of patients whom they called sympatheticotonics and vagatonics, but later physiological knowledge had gone much further than that, and it was now realised that the vegetative status of the individual was not regulated entirely by the sympathetic or the vagus nerve supply. It was a question of the reaction of the tissues, as to whether they tended to be acid or alkaline; a question of the predominance of various ions, particularly those of calcium on the one hand, which stimulated the sympathetic, and potassium on the other hand, which stimulated the parasympathetic; a question of hormonic influences, and, according to McDonagh, a question of the size of the protein particles. In people whose metabolism was dominated by the vagus, parasympathetic, side of their vegetative system the tendency was for the protein particles to be large, whereas they were small in the sympathetic dominants. Anyone who was interested in the subject and watched people in trains and trams, and so forth, could build up a very great deal from it by classifying people according to whether they were dominated by the one or by the other side of the vegetative system. One could then come to the question of temperament, of psychology, of reaction to infections, or reaction to emotions, and so forth. He thought there could be no doubt at all clinically that in a greater or a lesser degree the vast majority of the inhabitants of the world could be put into one or the other group.

Mr. W. A. Bulleid said he realised from what Mr. Broderick had said that the protein ions which Mr. Broderick had shown under the microscope that evening varied with the dominance of the sympathetic or the parasympathetic system, but he was not clear whether Mr. Broderick attributed the dominance to the protein particles in the blood or *vice versa*. Why were the protein particles large in the parasympathetic dominant and small in the sympathetic dominant? Was it because of the dominance of the particular nervous system, or was the nervous system the cause of the size of the particles?

Mr. Broderick said he wanted to make it quite clear that the modern physiological teaching was that the constitution or diathesis was due to what was now known as the vegetative system in contradistinction to the vegetative nervous system, and the build of the vegetative system was due to a number of things interconnecting the one with the other—the size of the protein particle, the calcium-potassium ratio, and the hydrogen-hydroxyl ratio. If a patient was given large doses of alkali his protein particles would be hydrated; if the vagus was stimulated the protein particles would be hydrated, and at the same time the potassium would be increased in proportion to the calcium in the body cell. It was a little difficult—in fact, quite impossible—to say which was the essential feature, because they all reacted one with the other. If one enlarged the protein particle, as could be done by certain synthetic chemotherapic drugs, one altered the reactions of acids and alkalis in the tissues, one altered the relation of calcium to potassium and one altered the stimulatory threshold of the sympathetic and parasympathetic nerves. With regard to the question of sympathetic and parasympathetic dominants, there were very definite differences in the pathological conditions from which they suffered. All the conditions which were known as the allergic conditions—asthma, hay fever, urticaria, mucous colitis, eczema, angio-neurotic œdema—occurred only in the parasympathetic dominant, the reason being, according to McDonagh, that any of the protein poisons which brought about those conditions simply acted by enlarging the protein particles to such an extent that they became precipitated in the capillary lymphatics of the tissues. If they happened to be the mucous membranes of the nose, hay fever resulted; if they happened to be the capillaries of the skin, urticaria resulted, and so forth. A sympathetic dominant was never an allergic. A person who

got hay fever or asthma or any of the allergic conditions was a parasympathetic dominant, and if the members watched their own patients they would find—not in every case because other circumstances came in and upset it—that there existed a kind of immunity to caries in the allergics and that they got pyorrhœa in the early years, other things being equal.

Mrs. MICHAELIS said she would like to hear further opinions, from the purely orthodontic viewpoint, on the question of the absence of caries in Class 2 cases. She happened to have with her that evening a pair of models of a typical Class 2 case, which was badly mutilated by the loss of the lower six-year molars through caries and the incisors were also carious. She did not know whether she was particularly unlucky, but in her hospital clinic she had not found her treatment of Class 2 cases made any more easy by an absence of caries, and she would very much like to hear the experience of other hospital clinicians. It seemed to her that the question of stomatitis and gingivitis in such cases could be a purely mechanical one. The mouth was kept open and therefore the gingivitis occurred, its cause being nothing more complicated than that.

Mr. R. O. BARBER said he thought Mr. Broderick had neglected one of the most important people in connection with malocclusion, namely, the mother. On the analogy of caries being only the end-point of metabolic upset, malocclusion was, to his mind, an end-point due to a variety of causes. First, there were maternal hormones which were circulated in the mother's blood while the fœtus was developing. It was a well-known fact that the jaws in the fœtus did not develop at the same rate. The upper jaw suddenly shot ahead, and then the lower jaw, and he thought the alternating growth could quite possibly be influenced by some parasympathetic disturbance in the mother, which, if continued, would probably cause the development of malocclusion. With regard to the testing of the blood of the child, he would suggest that the mother's blood should be tested first, and then it would be discovered whether the child was likely to be a marked Class 2 or a marked Class 3 case. Again, the maternal hormones might be an indirect cause of irregularities in the jaws, chiefly in their occlusion and not in the arrangement of the teeth. For instance, it was the practice nowadays, he believed, for mothers to arrange that their children should be fed by nurses. That again must have some effect upon the child, because the mother would naturally think of this before the child was born, with the result that the hormones would be circulating in her blood, and when the child was born the natural methods of feeding were negligible. The members had probably seen a number of cases at various times which showed the deleterious effect of bottle feeding. He felt that that was to a large extent parasympathetic. In the latter part of the paper Mr. Broderick spoke of the removal and deposition of bone material at the expense of the jaws. Why should the jaws be affected more than the rest of the body ? Working on that basis, if the jaws were affected, then when dealing with a Class 2 case one would expect to find that the tibia, for instance, or the bones of the hand would be deformed in some way, but personally he had not experienced that. He believed that two German research workers had mentioned what they called the "congenital component," i.e. that a bone, no matter what it was, would always assume its normal shape and size unless there was some very grave ætiological upset. He did not think that the majority of children whom orthodontists saw had been affected in the way described, and he did not think the matter was explained by parasympathetic dominance.

Mr. GORDON TAYLOR said he wished to present another picture, i.e. that of the edge to edge bite. He would not say that no caries was found in the case of an edge to edge bite, but there was found a resistance to caries : the teeth seemed particularly hard and well

calcified. Then, later on, when the patients reached the early forties, pyorrhœa was found. He thought the edgeways cases were the cases of traumatic occlusion which one heard so much about, but whether it was traumatic occlusion or whether there was something in the patient himself which was responsible for the gum trouble, he left to Mr. Broderick to say. Personally he had noticed that a large number of patients with gastric ulcer had edge to edge bites. He presented that picture of the edge to edge bite—resistance to caries, early pyorrhœa and gastric ulcer—and he would like Mr. Broderick to evaluate the picture.

Mr. BRODERICK said that, with reference to the bones of the jaw being affected and not the bones of the rest of the body, that was a question which, as he had said in his paper, he knew nothing about, a question of strains and stresses due possibly to other symptoms of parasympathetic dominants, such as an increase in lymphatic tissue, and so on, giving differences in size of air passages, which would tend to alter the shape of growing bones in the jaw more than in other parts of the body. Definitely associated, as Mr. Cutler had said in his paper, with parasympathetic dominance was an increase in lymphatic tissue, which would, he took it, throw a greater strain upon such a condition as the size of the mandible, the depth of the glenoid fossa, and so on. He could not go further than that. With regard to the association of gastric ulcer with edge to edge bite, gastric ulcer was essentially a disease of the parasympathetic dominant, because the secretory nerve to the stomach was the vagus, and increased vagus action would tend to give a hyperchlorhydria. One could not dogmatise too much in that connection, because the hyperchlorhydria might also be due to spasm of the pylorus preventing a regurgitation of juice from the duodenum, and the innervation of the pylorus was sympathetic. With reference to the question of gingivitis, there had been a time when he had definitely differentiated certain types of marginal gingivitis from the marginal gingivitis which was the first sign of a commencing pyorrhoea. He would not be quite so dogmatic on that point to-day as he had been two or three years ago, because it was suggested that all inflammatory phenomena were brought about by a definite ratio of hydration to dehydration, and that infection took place only as that ratio was reached. The matter might be looked upon somewhat as a ladder, with pure dehydration as the bottom rung and pure hydration as the top rung. Though pure hydration and pure dehydration were very rare conditions, the pathological changes in the protein particles had almost always a proportion of dehydration to hydration. Thus the bottom rung of the ladder would be dehydration, and then would come dehydrato-hydration, hydrato-dehydration and hydration. The inflammatory part of that ladder would be a certain ratio of dehydration to hydration. If one put against that ladder dental lesions, there would be caries with the lower rungs, pure dehydration, and dehydrato-hydration with dehydration much predominating. A little further up one would get caries with gingivitis, then gingivitis, and then gingivitis and pyorrhœa, and then, as one reached the top, one would get Gottlieb's type of pyorrhœa, in which the gingivitis element was very small. Consequently one would expect to get more and more gingivitis as one got the parasympathetic innervation coming more into the picture, gingivitis becoming more and more pronounced until one reached the extreme parasympathetic dominants, when gingivitis would cease to exist.

THE Annual General Meeting of the Society for the year 1934 was held at Manson House, 26, Portland Place, W.1, on Monday evening, December 3rd, 1934. The President, Mr. BERTRAM SAMUEL, occupied the chair.

MINUTES.

The minutes of the previous meeting, held on Monday, November 12th, 1934, were read by the Hon. Secretary (Mr. ROBERT CUTLER) and were confirmed.

NEW MEMBERS.

The PRESIDENT welcomed the following new members: Mr. R. O. Barber and Mr. J. A. Rowlett.

VISITORS.

The PRESIDENT welcomed any visitors who were present and hoped that they would take part in the discussion that evening should they so desire.

HONORARY MEMBER.

On the proposition of the PRESIDENT, it was unanimously agreed that Mr. Montagu F. Hopson, one of the founders of the Society, should be elected an Honorary Member.

ELECTION OF MEMBERS.

The following candidates for membership of the Society were unanimously elected: Mr. W. A. Lilley, B.D.S.Manc., Public Health Department, 92, Bath Road, Hounslow, Middlesex; Mr. S. E. Lewis, L.D.S. Eng., 52, London Road, Twickenham, Middlesex; Mr. D. Reid, L.D.S.Glas., 31, Weymouth Street, W.1; Mr. G. Miron, L.D.S.Eng., 175, Kew Road, Richmond, Surrey; Mr. R. W. Tuck, D.D.S., L.D.S. Eng., 270, Earl's Court Road, S.W.5, and Mrs A. R. Gillies, L.D.S.Eng., 269, West End Lane, Hampstead, N.W.6.

ELECTION OF OFFICERS AND COUNCILLORS.

No private nominations having been received, the following Officers and Councillors for the ensuing year, who had been nominated by the Council, were declared by the PRESIDENT duly elected: President, Mr. A. L. Packham; Immediate Past-President, Mr. Bertram Samuel; Vice-Presidents, Mr. F. B. Bull, Mr. F. St. J. Steadman and Mrs. L. Lindsay; Secretary, Mr. R. Cutler; Treasurer, Mr. H. R. Evans; Curator, Mr. H. C. Highton; Librarian, Miss K. C. Smyth; Editor, Mr. M. A. Rushton; Councillors, Mr. N. Gray, Mr. H. Chapman and Mr. S. A. Riddett.

ELECTION OF AUDITORS.

The following two gentlemen were elected Auditors of the Society for the ensuing year: Mr. L. Boness, proposed by Mr. CUTLER, seconded by Mr. BULLEID; and Mr. J. A. Hudson, proposed by Mr. PILBEAM, seconded by Mr. BULL.

The HON. TREASURER (Mr. H. R. Evans) read the following report.

REPORT OF THE HONORARY TREASURER.

During the past year, the Society's income has been £282 15*s.* an increase of roughly £32 on the previous year.

The expenditure has been £193 5*s.* 11*d.*, approximately £10 less than in 1933. This leaves a credit balance of £89 9*s.* 1*d.*

The Society's assets are as follows: 500 National Savings Certificates; present value £531 5*s.* Cash on deposit £190. Cash at bank and in hand £121 2*s.* 3½*d.* Credit note D.M.Co. £2. Making a total of £844 7*s.* 3½*d.* as against £730 6*s.* 2*d.* last year.

Mr. George Northcroft, in proposing the adoption of the report, congratulated the treasurer on his admirable balance sheet. He suggested that some of the money in the possession of the Society should be spent on some useful object of research, as he did not think there was any need for the Society to save money except for the purpose of assisting at the next International Orthodontic Conference, which it was proposed to hold in Canada in 1937. He did not know whether the Society would be asked to take part in the Empire Meeting in 1936, but, if so, he hoped the invitation would be accepted. He would like to put forward a suggestion for the consideration of the Council, that the Society might offer entertainment or extend hospitality of some kind to the Empire orthodontists from overseas when they came to this country.

Mr. Bradlaw seconded the motion for the adoption of the report, and it was carried.

The Hon. Secretary (Mr. R. Cutler) read the following report :

The Honorary Secretary's Report, 1934.

It is my pleasure to report that the past year has proved a most successful one for our Society. The new headquarters have proved very satisfactory, and members will be pleased to hear that a long term lease has been arranged with the Royal Society of Tropical Medicine. The continued progress of the Society is illustrated by a study of the membership, when it will be noted that 17 new members have been elected, this comparing adequately with 20 in the previous year, 10 have resigned and so the membership now stands at 271, consisting of 254 ordinary members, 12 corresponding members, and 5 honorary members.

The average attendance at meetings is 66, this creating a new record. Seven meetings have been held on the usual dates, the papers and communications then given being of considerable practical and scientific interest.

The programme for 1935 is now complete, and members are assured of a new session which should prove acceptable to all sections of the Society.

On the motion of Mr. Bulleid, seconded by Mrs. Lindsay, the report was adopted.

The Hon. Librarian (Miss K. C. Smyth) read the following report :

Report of the Honorary Librarian.

All the books belonging to the Society have been collected from various places, and are now housed at 35, Devonshire Place, in the care of the Librarian, and are available for the use of members at all ordinary hours.

Suggestions for the welfare of the library will be gladly received, and offers of back numbers of orthodontic journals would be welcomed. It is hoped to make the library a vital part of the Society, and not merely a name.

The expenses for the past year amounted to the trifling sum of three shillings, and practically no money has been spent on the library for many years.

Mrs. Lindsay proposed the adoption of the report, the motion being seconded by Mr. Hovell and carried.

It was agreed that the thanks of the Society should be conveyed to Miss Smyth for housing the library.

Report of the Honorary Curator.

The Hon. Curator (Mr. H. C. Highton) said he had really nothing to report, but he would like to remind members of the Society that he had received very little response to the appeals he had made for material and he would welcome any offerings that would be of interest or value to the Museum.

BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS.

INCOME AND EXPENDITURE ACCOUNT, 1933 - 1934.

RECEIPTS.	1932-33 £ s. d.	1933-34 £ s. d.
By Members' Subscriptions	249 7 6	281 15 5
,, Deposit Interest	0 15 0	0 19 7
	£250 2 6	£282 15 0

We have examined the Books and Vouchers and certify the above Statement of Accounts to be correct.

(Sgd.) STUART W. SOUTHWOOD
L. RUSSELL MARSH } *Auditors.*

November 30, 1934.

PAYMENTS.	1932-33 £ s. d.	1933-34 £ s. d.
To Rent	48 15 0	50 0 0
,, Accommodation of Cabinets at Institute of Hygiene	1 14 0	
,, Removal of Cabinets to 26, Portland Place	0 15 0	
,, Making and fitting of panels to Cabinets...	1 12 0	
,, Printing and *Transactions*	69 7 5	66 11 6
,, Reporting	19 19 0	18 18 0
,, Refunded Subscriptions	7 7 0	10 6
,, Refreshments	23 5 0	22 1 0
,, Hire of Electric Table Standard and Tables	2 2 0	3 17 0
,, Hire of Kodascope	2 11 6	
,, Petty Cash	16 11 9	15 0 0
,, Bank debits	0 8 4	0 0 2
,, Insurance on Books and Badges	0 15 0	0 15 0
,, Legal charges in respect of Lease ...		6 5 6
,, Photographs of models for Demonstration	4 9 6	6 0 0
,, Expenses of Patient for Demonstration	3 3 0	
,, Loss on Exchange (Wilkinson) ...	0 5 7	
,, Income Tax...		3 7 3
	203 1 7	193 5 11
Balance	47 0 11	89 9 1
Total	£250 2 6	£282 15 0

ASSETS.

	£ s. d.	£ s. d.
500 National Savings Certificates, present value	... ...	531 5 0
Deposit at Bank	... ...	190 0 0
Cash at Bank	... ...	114 4 4
Cash in hand : Secretary	£3 4 4	
Treasurer	2 6 9	
Librarian	0 10 9½	
Editor	0 16 1	6 17 11½
Credit Note, D.M.Co.	... ...	2 0 0
TOTAL		£844 7 3½